CHANGES IN JAPANESE HOUSEHOLD INCOME, SAVINGS, AND CONSUMPTION

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CHANGES IN JAPANESE HOUSEHOLD INCOME, SAVINGS, AND CONSUMPTION

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When Japan experienced high economic growth, its society was characterized by low inequality in income, a high saving rate and a low consumption rate. However, after Japan's transition to slow economic growth, it was said that the society lost income mobility, and the inequality among households deteriorated. In addition, the aggregate household saving rate dropped drastically. Meanwhile, consumption expanded, which gave people more options regarding their expenditure. With this background, this thesis examines the impacts of these changes-- income mobility over time, savings rate changes, and intra-household allocation--using a long run panel data set for Japan.

Chapter 1 studies income mobility in Japanese society. Household income mobility at the macro level is measured by six different methods. The results show that as a whole, household income mobility became lower in the long-run. At the micro level, unconditional micro income mobility indicated that it is possible that poorer people would catch up with richer people. Finally, conditional micro income mobility also shows that there exists conditional convergence.

In Chapter 2, the causes for the decrease in the aggregate household saving are analyzed. The aggregate time series analysis reveals that the increase in the ratio of the aged population ratio partially explains the sharp decrease in the household saving rate. By using household level panel data, it

was found that savings driven by the motive of home ownership could partly account for this decrease in the saving rate. The increasing burden of education expenditure is among the strongest candidates for explaining the change. Finally, some weak indirect evidence in support of the target saving hypothesis is found.

In Chapter 3, the characteristics of intra-household allocation are discussed. Using the Slutsky symmetry test, the unitary model could not be rejected for the consumption behavior of one-person households. Meanwhile, the tests for SR1, distribution factor proportionality and linearity indicated that the collective model might explain the consumption behavior of two-person households. Finally, the hypothesis that three-person households could be represented by the collective model for two-person households could not be rejected.

BIOGRAPHICAL SKETCH

Masato Nakane was born in Tochigi prefecture, Japan, on November 18, 1975. He spent most of his youth in Iwatsuki, Saitama, a suburb of Tokyo. After he finished Kaisei high school, he entered the University of Tokyo and obtained his bachelor's degree in Liberal Arts in 2000. After that, he began to work at Japan International Cooperation Agency until 2004. He obtained a Master of Science in Agricultural Economics at Cornell University in 2007.

In 2006 Masato entered Ph.D. program in Applied Economics and Management at Cornell University. He earned a scholarship from the World Bank in 2006 and an assistantship from Cornell University in 2007 and 2008. He completed his Ph.D. and submitted his research on "Changes in Japanese Household Income, Consumption, and Savings".

Masato's career goals include using his background in applied econometrics and development economics to address the establishment of more equal and more wealthy societies through healthy market economies in developed and developing countries.

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CHAPTER 1

INCOME MOBILITY IN JAPAN

1. Introduction

Japan experienced its highest economic growth rate in the 1960s, allowing the country to establish a more egalitarian. Most people in Japan considered that they belonged to the middle-income class, and in fact they did. The bottom 10th percentile of earners accounted for 2.3 percent of the national capacity in Japan, whereas in the U.S. the bottom 10 percent accounted for only 1.0 percent of the nation's wealth. According to the OECD, at the beginning of the 1980s, Japan was one of the most equalized societies among developed countries.

However, this situation started to change in the early 1980s. Japan experienced a bubble economy, where housing and land prices increased at an unprecedented pace. Instead of saving their income in bank accounts, people started to invest their money in property or land. As a result, the real estate prices accelerated drastically although the prices of goods did not climb so much. This frantic economic activity came to an end at the end of the 1980s, and was followed by what became known as the "ten lost years". In the 1990s, the Japanese economy experienced a long recession and suffered from high unemployment and low GDP growth.

The Japanese government tried to bring the economy out of recession, to create more job opportunities, and to reform the financial industry, using labor policies as well as monetary and fiscal policies. As a result, the structure of the labor market has changed and at present lifetime employment is no

longer the norm. Since the middle of 1900's, private banks have been required to establish more rigorous standards for lending money and to maintain higher amounts of capital. At the same time, the stock market has been made more open, and more and more companies depend on stock or bonds issues to raise capital for investment. This has strengthened the large size export-oriented companies because they can obtain capital from foreign investors on the stock market. On the other hand, medium and small size companies have found it difficult to gather capital because they mostly depend on private banks for their investment. This causes the wage gap between employees at large companies and those at medium and small companies to widen.

At the same time, the country's demographic structure and people's lifestyles are also changing; the ratio of the elderly to the working population has been increasing, whereas the number of children has been decreasing. In terms of lifestyle, aging parents used to live together with their adult children and the generations took care of each other. For example, elderly parents were in charge of household chores and the adult children worked outside the home. Now, many elderly people live separately from their children and form their own independent households. This also has an effect on income inequality. Previous studies reveal that the difference in income among old generations is larger than the difference among young generations. Therefore, the fact that the number of households, only consisting of elderly people, goes up might raise the inequality in the society although the social structure does not change.

In fact, under these socio-economic conditions, the income disparity between the rich and the poor has increased, as indicated by an increase in Japan's Gini coefficient. Now this coefficient's value is ranked in the middle of

OECD countries, proving Japan does not have the most equal society any longer. Some empirical studies have investigated the relation between enlarged income disparity and some specific economic phenomena in Japan. Ohtake and Saito (1998) investigated this inequality and its causes, using the consumption inequality method. They analyzed how consumption inequality within a fixed cohort grows with age, using Japanese household micro data. Following the method developed by Deaton and Paxson (1994), they obtained the following conclusions. First, consumption inequality starts to increase at the age of 40. Second, younger generations face a more unequal distribution from the beginning of their life-cycle. Third, a half of the rapid increase in the economy-wide consumption inequality during the 1980s was caused by population aging.

Their study on inequality in Japanese society used cross-section data. These data showed the inequality at specific points, but they did not show the dynamics of inequality in Japan because the sample households change from one survey to another. However, if there is high income mobility in a society, inequality does not necessarily worsen even though the Gini coefficient rises (Fields 2007). This is because at any single point in time, a household may belong to the lowest 10th percentile group but at another point, it might be included in the highest 10th percentile due to changes in their socio-economic circumstances. If so, in terms of lifetime income, the overall inequality in the society does not become worse at all. Thus, income mobility should be more carefully examined and the dynamic aspect of the inequality in Japan should be explored. Now that inequality as measured by the Gini coefficient is increasing, if income mobility is not observed, then the situation is likely to serious.

In this paper, income mobility in Japan is investigated both by macro and micro measurements using panel data. Section 2 explains the different measurements and section 3 describes the data set. As is often the case with panel data, this data set also has a certain amount of attrition and the attrition bias is also inspected in this section. Section 4 and 5 examine the results of income mobility measured by macro and micro analysis respectively. Finally, section 6 states the conclusion and policy implications based on those conclusions.

2. Methods to Measure Income Mobility

One agreed definition of income mobility is “how much income each recipient receives at two or more points in time” (Fields 2007). Other than this point, income mobility means different things for different people. There are three issues that help determine which kind of mobility analysis is dealt with; intergenerational versus intragenerational, changes in the distribution of what among whom, and macro-mobility versus micro-mobility.

The first issue in this topic refers to the aspect of income mobility is intergenerational or intragenerational. In this paper, income mobility is analyzed in the intragenerational context only because of the limitation in data. For the second issue, an indicator of social or economic status and the choice of recipient unit must be fixed. This research deals with mobility of income per capita among households. Third, the mobility questions are categorized into two groups; macro and micro. Macro-mobility studies research on the degree of economic mobility there is. On the other hand, micro-mobility studies research on what determines the income changes of individual households.

This paper analyzes both macro and micro-mobility and in this section, the measurements this paper adopts is explained.

2.1 Macro Income Mobility

There are many different ways to measure macro mobility. Most previous papers, such as Hungerford (1993), Gittleman and Joyce (1995, 1996), Sawhill and Condon (1992), Burkhauser, Holtz-Eakin, and Rhody (1997), Buchinsky and Hunt (1996), and Gottschalk and Huynh (2006), describe just one or two mobility concepts, which vary from study to study. However, Buchinsky et al. (2003) and Fields (2007) examine six concepts of mobility that have been used in the literature. There is no single best measure of macro mobility. One concept or measure of macro mobility is not necessarily more important than any other for understanding the amount of mobility taking place in a country over time. Each concept measures something quite different, and it is important to look at all of them to gain a more complete understanding of how much mobility there is in any given year and how the amount of mobility has changed over time.

This paper uses the six different measurements explained by Fields (2007) although some of them have been adjusted to become more suitable for our data set. The following notation is used in this section.

$x = (x^1, \ldots, x^n)$ = vector of incomes in an initial year

$y = (y^1, \ldots, y^n)$ = ordered vector in a subsequent year

$M(x, y)$ = extent of mobility associated with the transformation $x \to y$

In Fields' index, mobility towards equality depends on the relations between inequality of average income to inequality of initial income: if average income is distributed more equally than initial income, mobility is judged to have equalized longer-term income relative to initial income.

More recently, interest in mobility has attained a wider scope and is not only interested in gauging the distributional impact of income changes, but also the nature and origin of the changes in economic well-being. As Fields (2001) puts it: "Economic mobility studies are concerned with quantifying the movement of given recipient units through the distribution of economic well-being over time, establishing how dependent one's current economic position is on one's past position, and relating people's mobility experiences to various influences." Changes in economic well-being can be interpreted and thus measured in a wide variety of ways. Fields categorizes these different interpretations into six notions of mobility (in addition to mobility towards equality): time dependence, positional movement, share movement, non-directional income movement, directional income movement, and mobility as an equalizer of long-term incomes.

(1) Mobility as Time Dependence

Mobility as time dependence refers to the extent to which an individual's current economic well-being is determined by his or her economic well-being in the past. In an intragenerational context, the final income of mobility is explained by his or her own base income. Time dependence is gauged by measures of association such as Cramer's V or Pearson's correlation coefficient:

$$M_1(x,y) = 1 - \frac{Cov(x_i, y_i)}{\sqrt{Var(x_i)}\sqrt{Var(y_i)}}$$

In this case, the farther from zero the measurement between the initial income x_i and the final income y_i, the more mobility-as-time-dependence there is.

(2) Positional Movement

Positional movement is defined as the movement of individuals among ranked positions in the income distribution. People experience positional movement only if they change ranks. A greater value in positional movement implies a greater number of movements by individuals and/or a wider actual move in the ranking by individuals.

$$M_2(x,y) = \sum_{i=1}^{n} \frac{|P(y_i) - P(x_i)|}{n}$$

where $P(y_i)$= the percentile of individual i in a subsequent year, $P(x_i)$= the percentile of individual i in an initial year, and n is the number of observations.

(3) Share Movement

Share movement takes place if and only if a household income per capita rises or falls relative to the mean. This movement reflects the frequency and magnitude of these household share changes. One advantage of share movement is the mean absolute value of share changes;

$$M_3(x,y)=\frac{1}{n}\sum_{i=1}^{n}\left|\frac{y_i}{\mu_y}-\frac{x_i}{\mu_x}\right|,$$

where $\mu(x)$ and $\mu(y)$ are the means of the distributions x and y respectively.

(4) Non-directional Income Movement

Non-directional income movement gauges the extent of fluctuation in a household income.

$$M_4(x,y)=\frac{1}{n}\sum_{i=1}^{n}\left|\log y_i-\log x_i\right|$$

(5) Directional Income Movement

Directional income movement refers to the direction of the income change as well as the amounts. This measurement may be judged using a concave valuation function as follows.

$$M_5(x,y)=\frac{1}{n}\sum_{i=1}^{n}\left(\log y_i-\log x_i\right)$$

(6) Mobility as an Equalizer of Long-term Incomes

This mobility considers how the income changes experienced by households cause the inequality of longer-term incomes to differ from the inequality of base-year incomes. Fields (2005) proposed the following measure.

$$M_6 \equiv 1 - \left(I(a)/I(x)\right),$$

where x = the vector of base-year incomes, y = the vector of final-year incomes, a is the vector of average incomes, the i'th element of which is $a_i \equiv (x^i + y^i)/2$, and $I(.)$ = a cross-sectional inequality measure such as the Gini coefficient or the Theil index. In this paper the Gini coefficient is adopted.

In section 4, the one-year, three-year, and eleven-year macro-mobility is calculated using these six different measurements.

2.2 Micro Income Mobility

As previously mentioned micro-mobility analyzes which households have larger income changes than others and what are the determinants of these changes. In particular, economists have focused on estimating two types of mobility, unconditional and conditional mobility (Fields 2006). To begin answering the question of how income mobility has changed over 13 years, first a mobility profile is presented. This profile shows the mean and standard deviation of one-year household income changes for different subgroups of individuals. These statistics for individuals are broken down by initial earnings quartile, age, education and parent's income level. Then bivariate and multivariate regression models are used to study the correlations between earnings changes and each variable while holding the other variables constant. The regression model in this study specifies household income per capita changes as a function of initial earnings in stages and a linear function of age, education, and parent's income level. This mobility is not interpreted as a causal model of earnings changes, but rather a way of answering the

question of which individuals experience the most positive earnings changes, holding other things equal.

2.2.1 Unconditional Mobility

Unconditional mobility is used to estimate to what extent there is convergence between the incomes of rich and poor households over time.

Traditionally, questions of unconditional mobility have been answered by focusing on the bivariate relationship between income changes and initial income. In particular, many studies have estimated a model in which the income change of household i at time t, $\Delta Y_{i,t}$, depends linearly on lagged income $Y_{i,t-1}$, i.e.,

$$\Delta Y_{i,t} = \alpha + \beta Y_{i,t-1} + u_{i,t}$$

The parameter β in this model measures the extent to which unconditional convergence occurs. If β<0 convergence is said to exist, if β>0 divergence is said to exist between the rich and the poor, and if β=0 earnings change is unaffected by initial earnings.

This convergence can be affected by many factors such as human capital characteristics of the individuals, local market conditions, aggregate economic shocks, state dependence, and so forth. However, the main goal of unconditional mobility studies is not to explore these factors, but rather start by documenting whether this convergence process has taken place or not.

Documenting this process is relevant because if there is convergence between the incomes of initially rich and initially poor households, this would

equalize the long term distribution of income, and it would be indicative of the possibility for equality of opportunity in a society.

2.2.2 Conditional Mobility

Studies of conditional mobility estimate the convergence of incomes to a conditional mean. In other words, the presence of conditional convergence means that household incomes are converging to their predicted household level. This predicted level is usually determined by a set of observable and unobservable characteristics like gender, age, education level, ability, and so forth.

In practice, many conditional mobility studies have estimated linear models where income mobility depends on initial income, and on a set of observable time-varying characteristics $X_{i,t}$ and time-invariant characteristics Z_i,

$$\Delta Y_{i,t} = \alpha + \beta_1 Y_{i,t-1} + \beta_2 \Delta X_{i,t} + \beta_3 Z_i + \varepsilon_{i,t}$$

If there are a large number of observations for each individual over time, the estimation of this equation could control the effect of unobserved fixed characteristics, as in the literature on dynamic panel models.

In the case of this equation, the coefficient β_1 estimates whether mobility is strongly conditionally convergent. If β_1 <0, there is strong conditional convergence; if β_1 >0, there is strong conditional divergence; and if β_1 = 0, the pattern of income change is neutral with respect to initial income, which means income recipients in different parts of the initial income distribution gain the same amount in yen.

Estimating this equation, or some modified version of it, is of interest mainly because it can help us elucidate the underlying determinants of income change. In particular, it can estimate the impact of socioeconomic characteristics such as education, age, gender, or sector of employment on mobility, conditional to the initial income level. Also, if the number of observations for each household is moderately large it can help us determine if the impact of lagged income on mobility is due to situation dependence, to some unobserved ability, or some other possible factor.

It is important to remark that in both micro-mobility equations, income can be measured in currency units or in logarithms. However, the interpretation of the parameters is different in the two cases. In particular, taking logarithms of income gives less weight to the income changes of richer individuals and a higher weight to the income changes of poorer individuals. Also, the logarithmic transformation approximates proportionate changes instead of changes in currency units.

3. Data

The Institution for Research on Household Economics (IRHE) has designed, implemented and analyzed the Japanese Panel Survey of Consumers (JPSC) with a focus on changing lifestyles. This employs the panel research method to track the same individuals over multiple periods of time. Cohort A consists of a group of young women aged between 24 and 34 who were selected from across Japan in 1993 for an in-home questionnaire survey. Cohort B, consisting of women aged between 24 and 27, and cohort C, consisting of women aged between 24 and 29, were added respectively in 1997 and 2003. The IRHE selected sampling points by two-stage stratified

random sampling. Then, they chose samples by systematic sampling using the registered address records until enough number of samples was collected. The relatively high response rate of this annual survey has overcome the inherent disadvantages of a panel survey. The IRHE have designed, implemented and analyzed this research project with a focus on changing lifestyles. Many of the people selected as participants in the study are at an age where their previously similar lifestyle paths begin to branch out and diversify. The objective of this study has been to identify various factors and problems associated with these changes and differences in the lifestyles of the study participants.

As is often the case with panel data, JPSC also has a problem with attrition. Cohort A had a sample size of 1,500 when the survey started in 1993. After 13 years, 904 remained and had 596 dropped out. The rate of drop in the thirteen years is 39.7%. This was not especially bad compared with other panel data such as the Michigan Panel Study on Income Dynamics (PSID), but it is still necessary to check for attrition bias. Cohort B was added in 1997 and the original sample had 500 but decreased to 292 in 2005, which means 41.6% of the total samples dropped out. Cohort C had 836 samples, but the number fell to 674 in 2005. As only three years passed since Cohort C was added, a relatively small portion of the samples, 19.4%, had dropped.

There are two methods used to check attrition bias. One is to compare the mean value of each variable between the remaining samples and the attritors and to check the difference in the values by t-test. The other is to do a probit regression, whose dependent variable takes value one if the sample dropped some time during the survey period and zero if the sample remained constant until 2005. Since each cohort participated in the survey in a different

year, the attrition bias is checked separately using the characteristics measured in each cohort's starting year. The independent variables are household income per person, age, squared age, education, marital status, the number of family members, and living place. The living status is a dummy variable which takes the value of one if the sample lives with her parents and zero otherwise.

Table 1.2 shows that, in cohort A, attritors have higher household income per capita at 5% significance level although cohort B and C do not have significant difference in this variable. The probit result, table 3.3, indicates that in cohort A, attritors significantly have more household income per capita, too. Therefore, in analyzing micro income mobility, the model will be adjusted by the Inverse Probability Weighting method (IPW) and the regression results will be compared with those of the original model. Also, according to table 1.2, in all cohorts, attritors have significantly more unmarried samples than the remaining samples. Table 1.3 also shows that the attritors include more unmarried samples than the remaining samples.

These results can be explained by the research conducted by Sakamoto (2006). Sakamoto investigated attrition bias for JPSC and concluded that when people are about to get married or have just married, they tend to drop out of the survey. When women get married, they usually move to a new residence and sometimes it's difficult to track them. Even if the questionnaires reach the samples again, their husbands might have disagreed with the wives continuing to participate in the survey because some questions are related to husbands' privacy. This is why samples tend to drop when they get married. Consequently, attritors have a higher rate of unmarried samples who dropped out just before or after their marriage.

Table 1.1 Samples in JPSC

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cohort A Female Age 24-34 in 1993 1,500 Obs. In 1993	1,500	1,422	1,342	1,298	1,255	1,196	1,137	1,102	1,059	1,032	980	944	904
Cohort B Female Age 24-27 in 1997 500 Obs. In 1997					500	442	412	386	366	344	323	312	292
Cohort C Female Age 24-29 in 2003 836 Obs. in 2003											836	724	674

Table 1.2 Variable Means between Remaining Samples and Attritors in JPSC

	Cohort A		Cohort B		Cohort C	
	Remaining	Attritors	Remaining	Attritors	Remaining	Attritors
Household Income	188.651	208.201**	210.1225	223.356	210.052	232.243
Number of Obs.	829	475	261	197	637	146
Age	29.959	29.737	25.459	25.490	26.599	26.333*
Number of Obs.	904	518	292	208	674	162
Junior High	0.020	0.023	0.062	0.068	0.037	0.050
Number of Obs.	901	514	291	206	669	161
High School	0.656	0.634	0.553	0.563	0.504	0.540
Number of Obs.	901	514	291	206	669	161
Junior College	0.202	0.210	0.237	0.175*	0.241	0.186
Number of Obs.	901	514	291	206	669	161
University	0.122	0.132	0.148	0.194	0.218	0.224
Number of Obs.	901	514	291	206	669	161
Marital Status	0.728	0.670**	0.445	0.341**	0.442	0.327**
Number of Obs.	904	518	292	208	674	162
Family Member	4.162	4.064	3.616	3.399	3.540	3.179**
Number of Obs.	904	518	292	208	674	162
Urban	0.803	0.799	0.842	0.870	0.832	0.840
Number of Obs.	903	518	292	208	674	162
Rural	0.197	0.201	0.158	0.130	0.168	0.160
Number of Obs.	903	518	292	208	674	162
Live with Parent	0.524	0.543	0.599	0.594	0.568	0.509
Number of Obs.	895	512	289	207	673	161

* Significant at 10% level

** Significant at 5% level

Table 1.3 Results of Probit between Remaining Samples and Attritors in JPSC

	Cohort A		Cohort B		Cohort C	
	Coefficient	Robust S.E.	Coefficient	Robust S.E.	Coefficient	Robust S.E.
Household Income	0.000	0.000*	0.000	0.001	0.001	0.000
Age	-0.125	0.240	-0.330	3.100	-0.769	1.140
Age squared	0.002	0.004	0.008	0.061	0.014	0.022
Junior High	-	-	-	-	-	-
High School	-0.036	0.272	-0.039	0.281	-0.152	0.278
Junior College	0.010	0.281	-0.362	0.309	-0.339	0.294
University	-0.032	0.290	-0.085	0.320	-0.267	0.300
Marital Status	-0.103	0.114	-0.418	0.186**	-0.582	0.171**
Family Member	-0.009	0.036	-0.007	0.061	0.059	0.055
Urban	-	-	0.181	0.190	-	-
Rural	0.050	0.095	-	-	0.050	0.152
Live with Parent	0.000	0.112	-0.165	0.215	-0.564	0.190**
Constant	1.587	3.589	3.440	39.472	9.965	15.066
Number of Obs.		1285		451		776
Wald chi2		9.10		12.7		23.09
Prob > chi2		0.5223		0.2410		0.0104
Pseudo R2		0.0052		0.0209		0.0331
Log pseudolikelihood		-836.612		-301.744		-359.952

4. Macro Household Income per Capita Mobility

In this section, the results of household income per capita mobility in three periods of different length of time, 1-year, 3-year, and 11-year are discussed. Before that, the macro economic situation and trend of some inequality measurements are reviewed to understand the background of this period. After investigating the macro mobility measurements, an interpretation of these results is discussed especially in terms of the structural change in the labor market in Japan.

After the bubble economy, a major recession started at the end of 1980s and it took a long time to recover, especially in the banking sector.

Consequently, GDP growth stayed low level till 2002 (Figure 1.1 and 1.2). Particularly, in 1997, the currency crisis happened in Asia and exports to Asian countries declined, which resulted in negative GDP growth rate, although the Japanese yen did not depreciate so much and banking system also worked normally. In 2002, IT bubble collapsed in the US and since the US was the largest trading partner for Japan, this also damaged the Japanese economy. After these shocks, GDP growth in Japan got close to potential rate. The unemployment rate did not change as drastically as GDP growth (Figure 1.3). Usually it takes some time for unemployment to change when some shocks hit the economy. Also, changes to unemployment are more related to permanent shocks than temporally shocks. Thus, during the period of recession, the unemployment rate got worse from 1994 to 2002 and started to improve after the economy recovered in 2003. At the same time, close observation of labor market enables us to understand that it has long-term trend (Figure 1.4). The ratio of non-regular staff to total labor is getting larger and larger and this continues even after the economy has recovered. Also, unlike regular staff wages, non-regular staff wages have been stable at a low level (Figure 1.5 and 1.6). This is because in Japan, companies give regular staff wages depending on their profit level through bonuses and do not change the number of employment so much. On the other hand, Japanese companies keep non-regular workers' wage at a certain level and adjust the labor cost by the employment number. Thus, when the economy is good, the company hires more non-regular staff and once the economy turns bad, they cut those workers.

Figure 1.7-1.10 represents the change in four different inequality measurements. Although these measurements have differences in detail, they

also indicate some similar movements. From 1994 to 1996, inequality declined and then it has an upward movement with some oscillation until 2001. In 2002, the inequality dropped once, and then it went up from 2003 to 2004. In 2005, some measurements show a decrease and other indicate an increase in inequality.

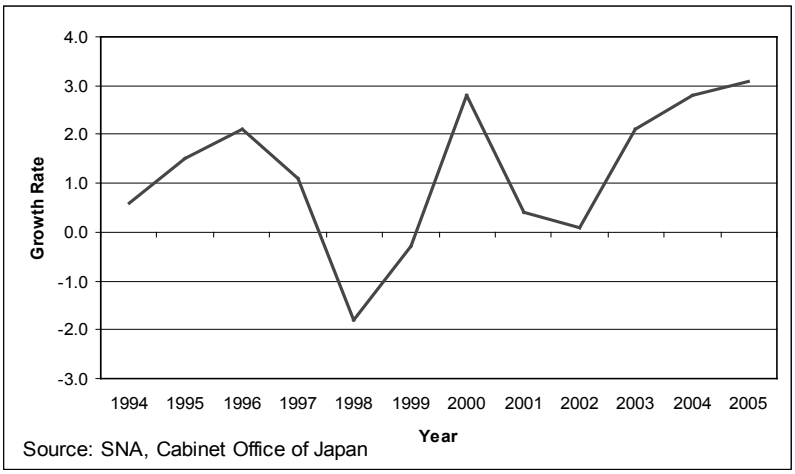

Figure 1.1 GDP Growth Rate

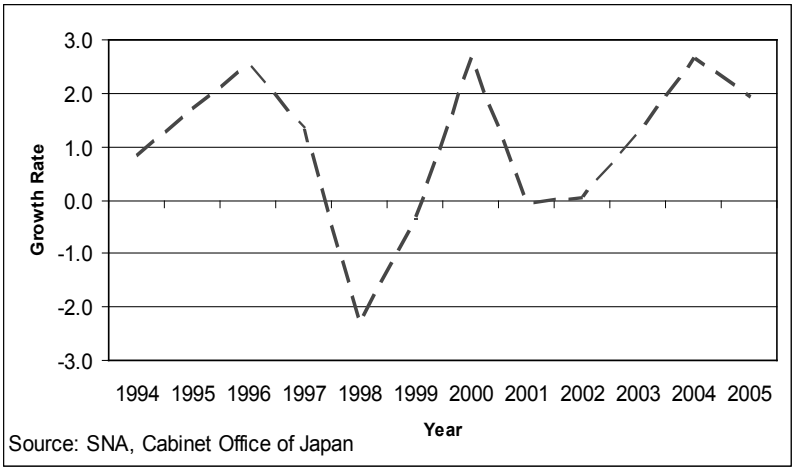

Figure 1.2 GDP per capita Growth Rate

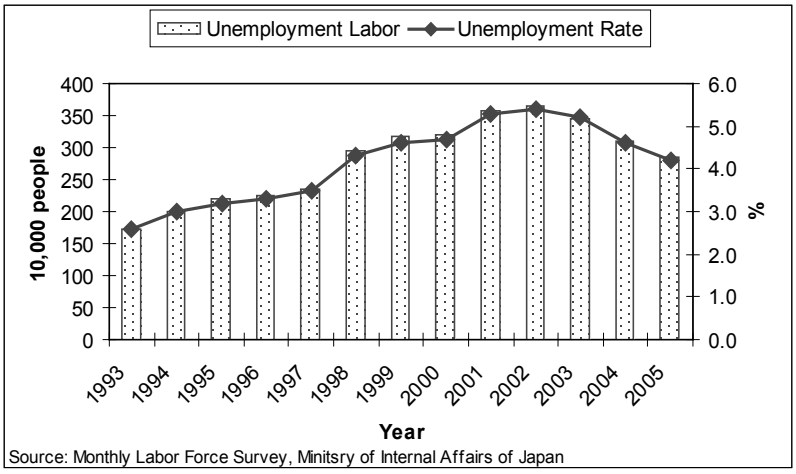

Figure 1.3 Unemployment Trend

Figure 1.4 Regular vs Non-regular Staff Ratio

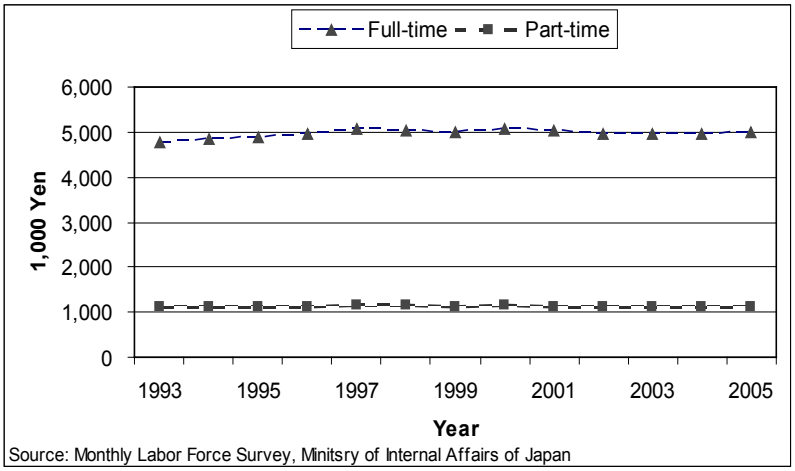

Figure 1.5 Annual Wage

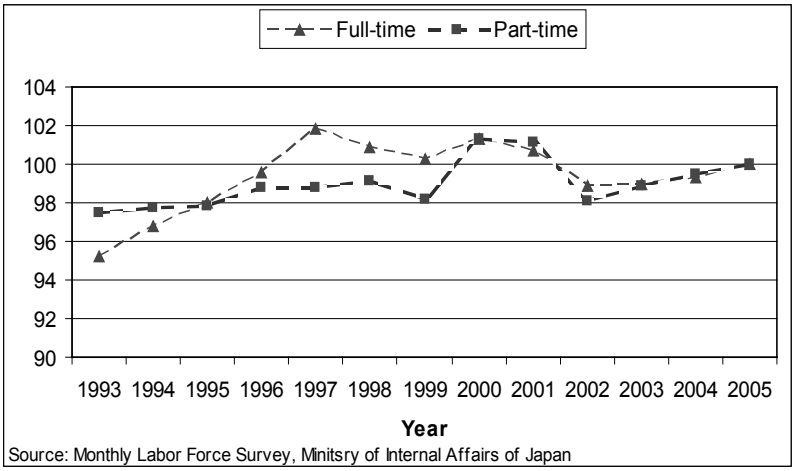

Figure 1.6 Wage Indices (2005 Wage = 100)

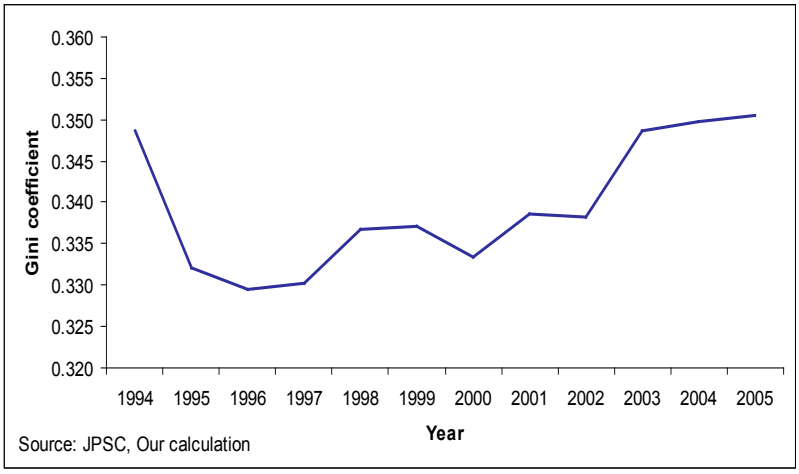

Figure 1.7 Gini Coefficient

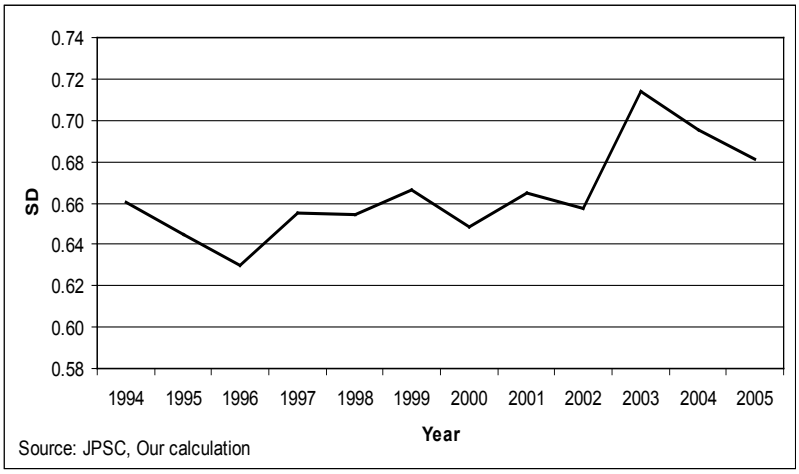

Figure 1.8 Standard Deviation of Household Income

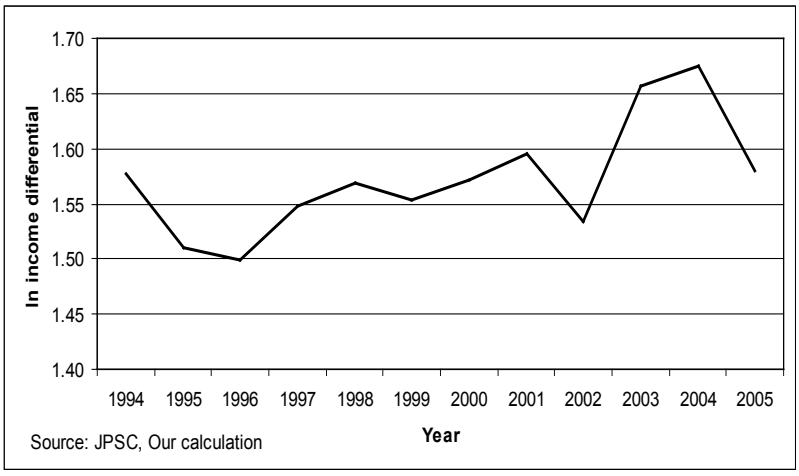

Figure 1.9 90-10 percentile log income differential

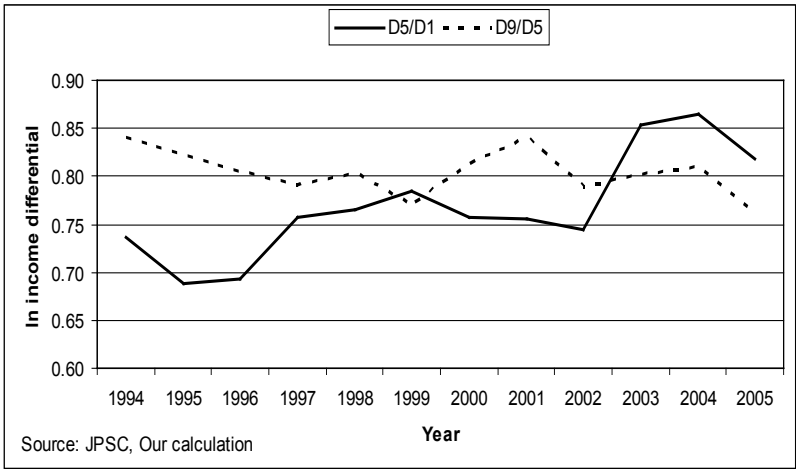

Figure 1.10 Log D5/D1 and log D9/D5

4.1 1-year Income Mobility

The movements of 1-year income mobility, measured by the six different concepts defined in section2, can be divided into two groups (Figure 1.11-1.16). One group contains mobility-as-time-dependence, direct income movement and mobility as an equalizer of long-term incomes, and the other contains positional movement, share movement and non-direct income movement.

The first group indicates that income mobility decreased from 1994-1995 to 1996-1997 and then increased until 2000-2001. After the mobility declined in 2002-2003, it climbed again. This movement is similar to the trend of GDP per capita growth rate. This makes sense because if GDP per capita grows, then people have more opportunities to earn a higher income. This fall reduces the correlation between the household income per capita in the base year and in the second year, which increases the mobility-as-time-dependence. Similarly, the fact that more people get a higher income raises the positive change of direct income movement. However, the increase in mobility as an equalizer of long-term incomes is not a self-evident result from GDP per capita growth. This might indicate that the income redistribution system in Japan works better when the gross national product rises.

The second group has a downward trend, except in 1997-1998 and in 2003-2004. This means that the fluctuation in the percentile rank between the rich and the poor or the share change of household income per capita had reduced more and more. It is possible that the structure of the labor market has changed. According to the figure regarding the rate of regular staff and non-regular staff to the total labor force, the ratio of non-regular staff increased from 1994 to 2005. However, the wage difference between these two different types of employees did not change so much. Thus, more and more people had been engaged in jobs as non-regular staff with consistently lower wages. This could explain why the positional movement and share movement went down over the long run.

The downward trend of the non-directional income movement indicates that the extent of fluctuation in household income per capita became smaller. According to the results of the second group, it can be said that not only their

percentile rank or share income movement but also their absolute value change in household incomes fluctuated less because of the structural change in labor market.

Next, the income mobility is analyzed according to four categories; education (Figure 1.17-1.22), initial income (Figure 1.23-1.28), cohorts (Figure 1.29-1.34) and parent's income level (Figure1.35-1.40). Income transfer from parents is considered to be an important factor on influencing the household income, too. However, the survey contains the data on intra-generation transfer from 1998 for married samples only. Thus, the data might have a bias, and the number of observations is not large. In addition, the amount of income from parents to their children correlated with the parents' income level across the available samples. Therefore, this paper will not analyze the income mobility by the amount of intra-generation income transfer.

According to the level of education, positional movement declined in all groups, which means that people's household income rank changed less within the group which has the same educational background. Except for the time dependence mobility measurement, the lower educated group is less volatile than the higher educated group.

According to quartile of household income per capita in the base year, all six measurements indicate that the mobility tends to decline in each group. At least within each quartile, the mobility becomes smaller but it does not necessarily mean that people stay in the same quartile for a long time.

By cohort, cohort A is divided into two smaller cohorts; Pre-bubble and Bubble cohort. People who started to work during the bubble economy belong to Bubble cohort, and those who started their career before the bubble economy belong to Pre-Bubble cohort. Previous studies mention that in Japan,

the economic situation under which people start to work has a large impact on their lives. This is because life-long employment is still common and working conditions are largely determined by the starting point of their career although some other factors such as marriage might have an important effect on people's lives. In most measurements, from 94-95 to 99-00, the pre-bubble cohort experienced less mobility than the bubble cohort. Then, in time dependence, directional movement, and mobility as an equalizer of long-term incomes, the pre-bubble cohort has a larger mobility than the bubble cohort, and in the other three measurements pre-bubble cohort has equal or less mobility than the bubble cohort.

By parent's income level, except for the directional movement, each group is inclined to decrease the mobility within the group but its path to immobility is different from group to group.

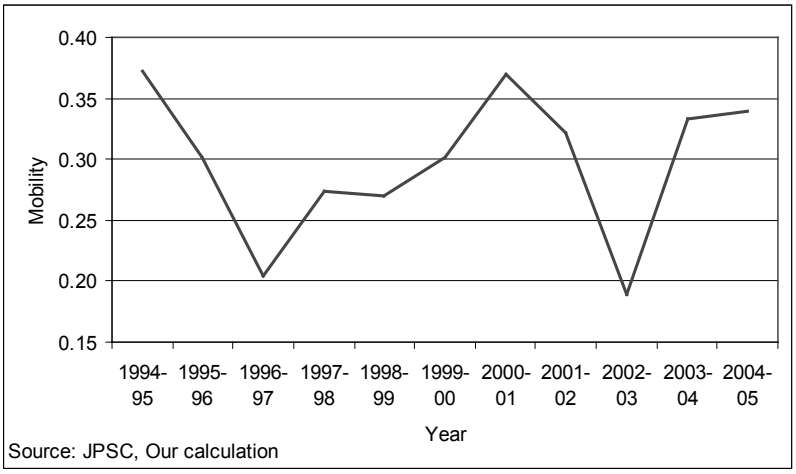

Figure 1.11 Time Dependence

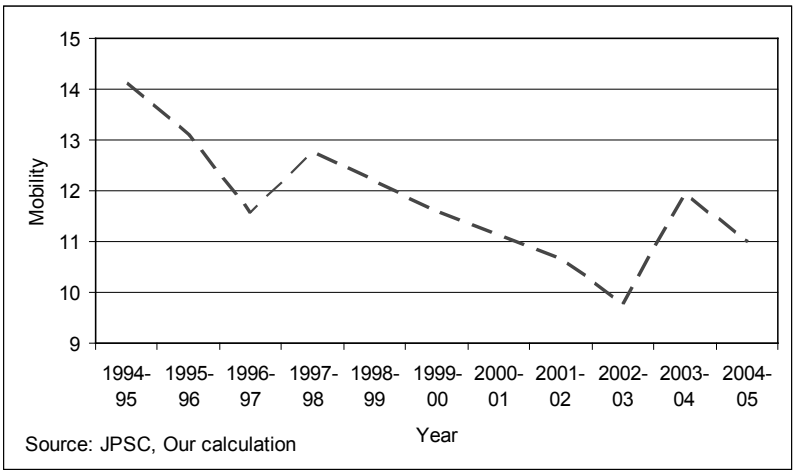

Figure 1.12 Positional Movement

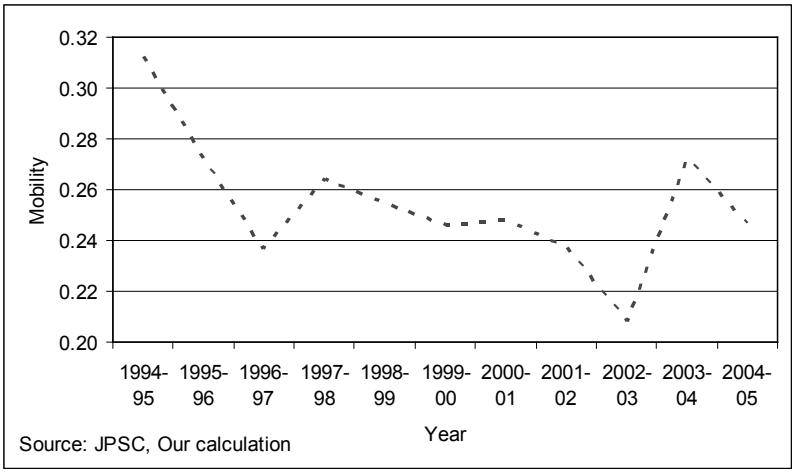

Figure 1.13 Share Movement

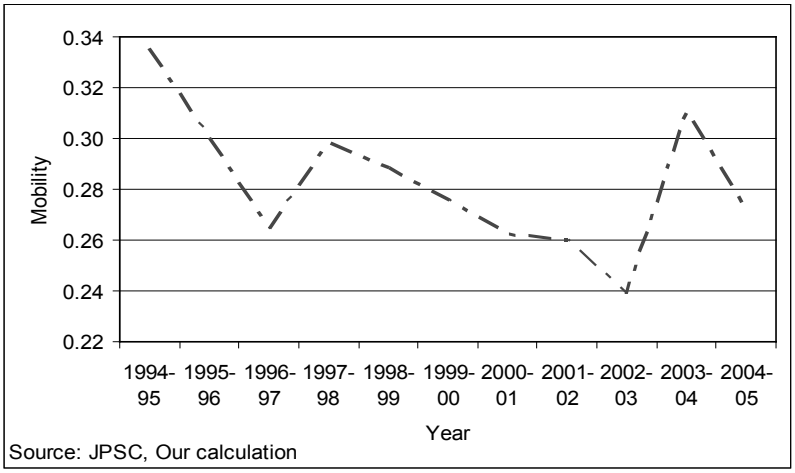

Figure 1.14 Non-directional Movement

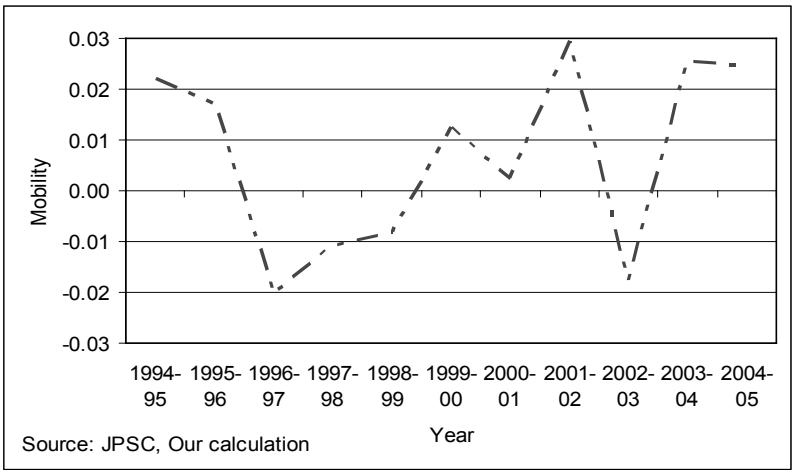

Figure 1.15 Directional Movement

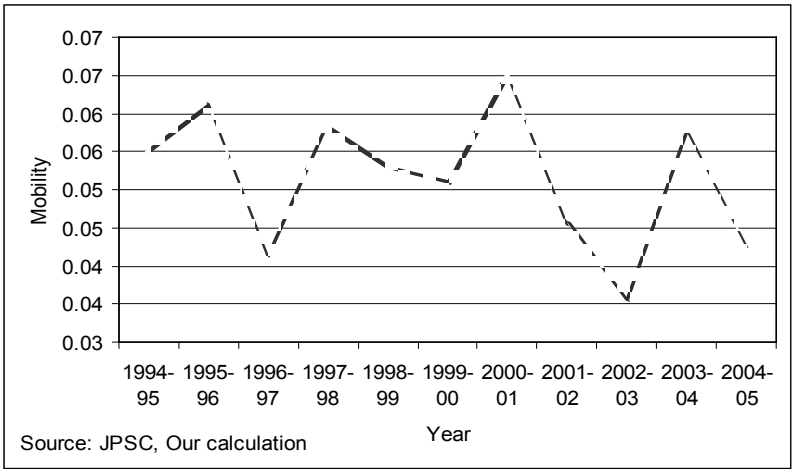

Figure 1.16 Equalizer for a long-term Income

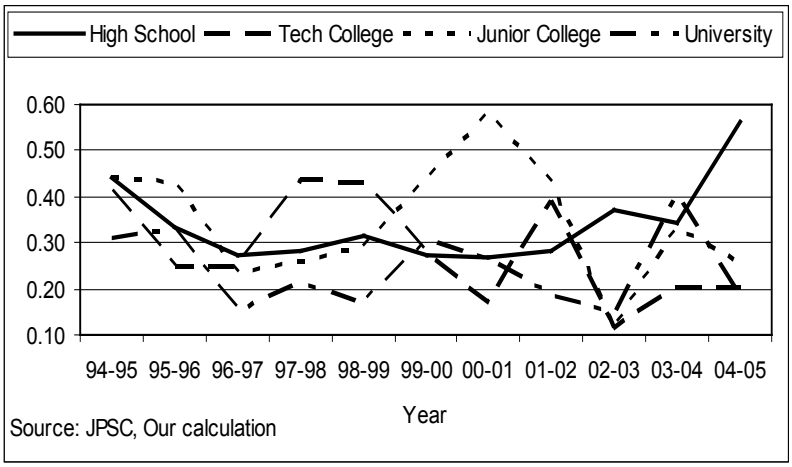

Figure 1.17 Time Dependence by Education

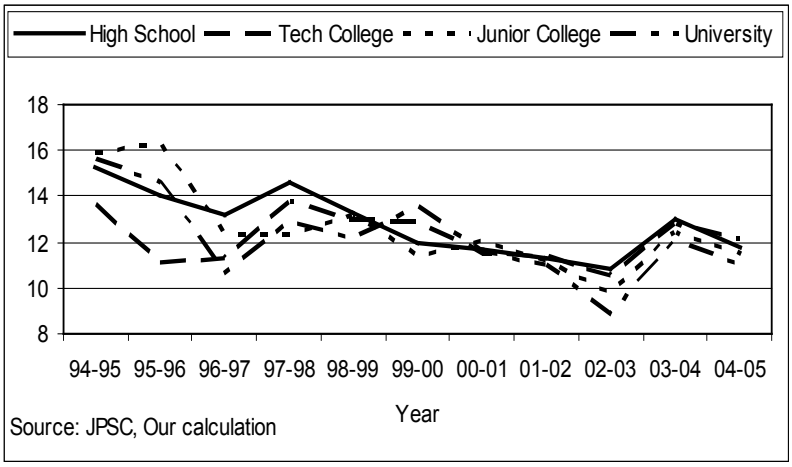

Figure 1.18 Positional Movement by Education

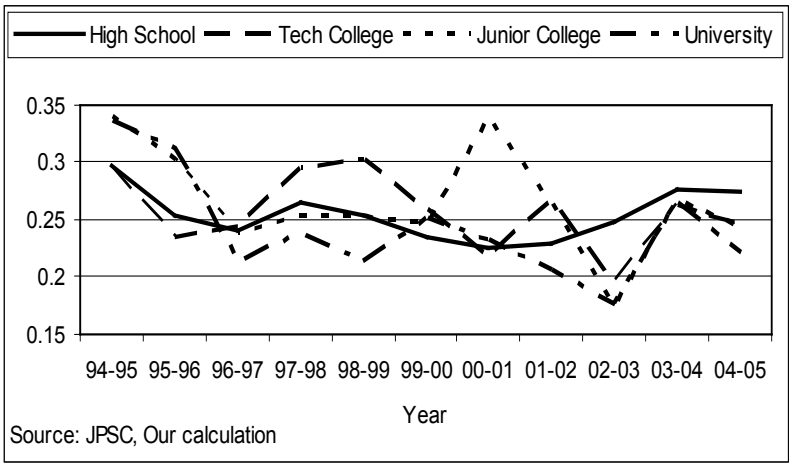

Figure 1.19 Share Movement by Education

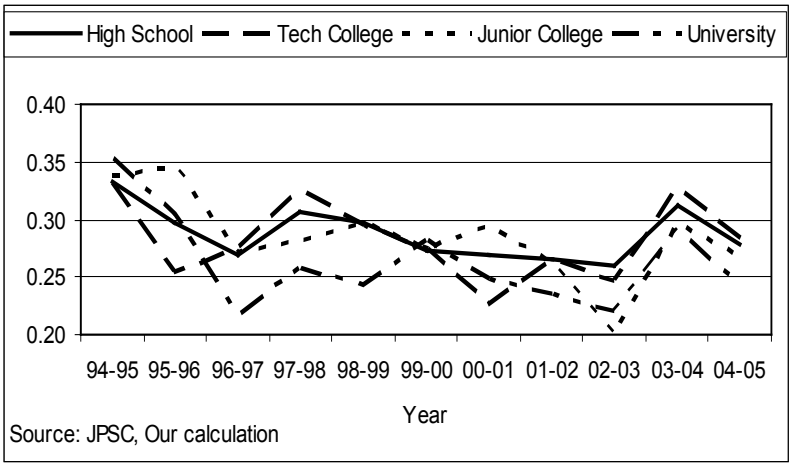

Figure 1.20 Non-directional Movement by Education

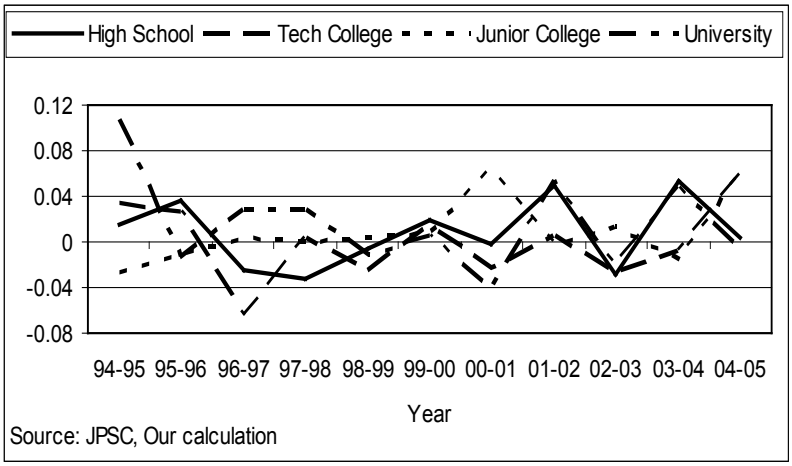

Figure 1.21 Directional Movement by Education

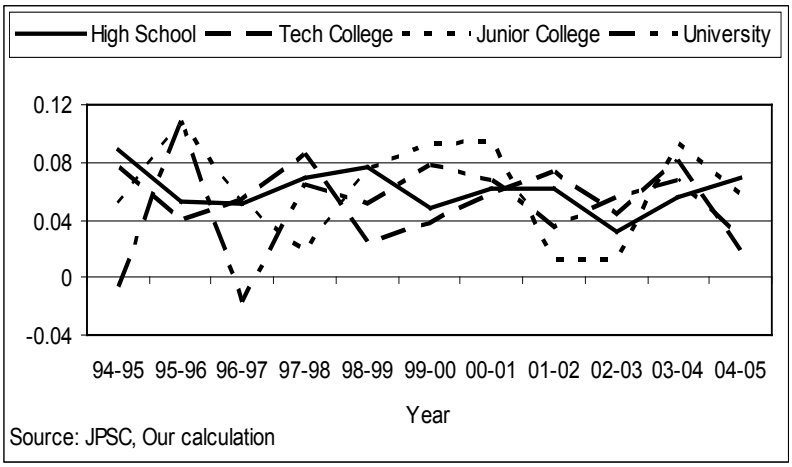

Figure 1.22 Equalizer for a Long-term Income by Education

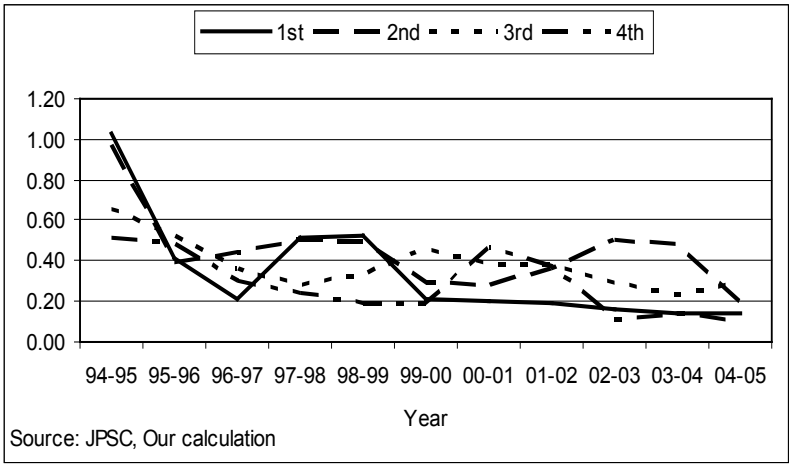

Figure 1.23 Time Dependence by Quartile in Base Year

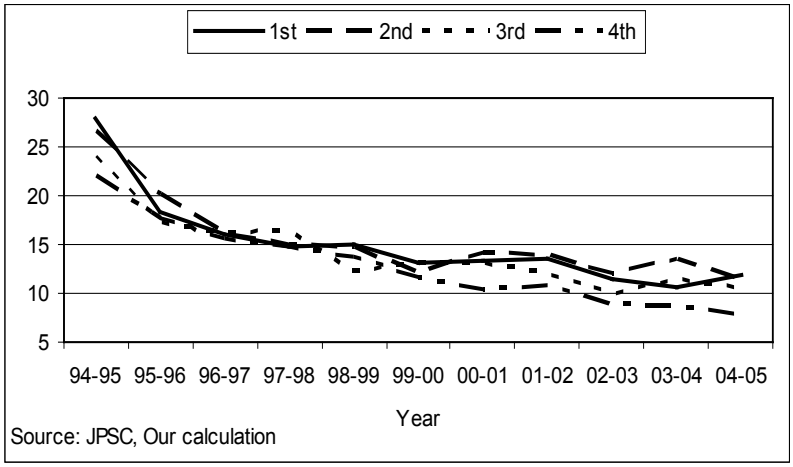

Figure 1.24 Positional Movement by Quartile in Base Year

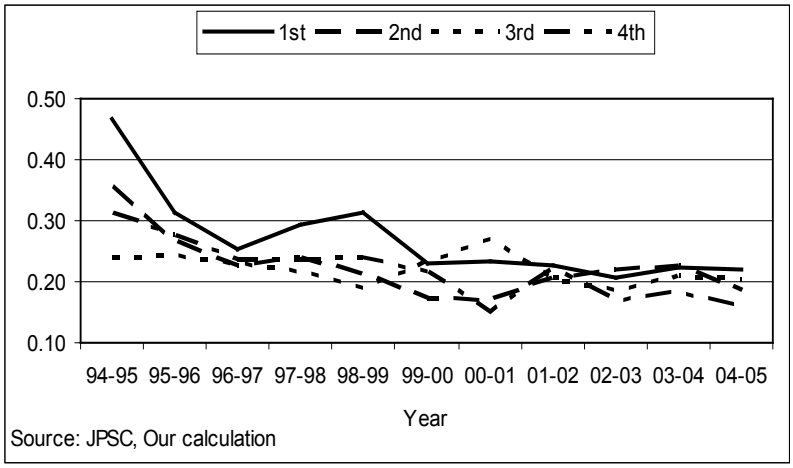

Figure 1.25 Share Movement by Quartile in Base Year

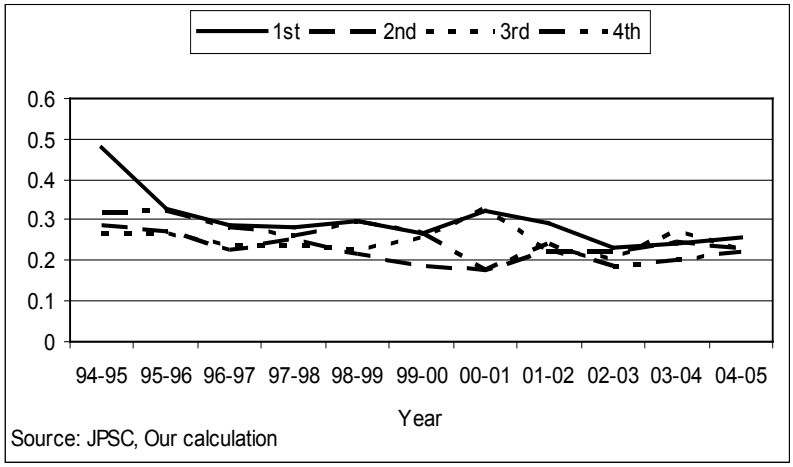

Figure 1.26 Non-directional Movement by Quartile in Base Year

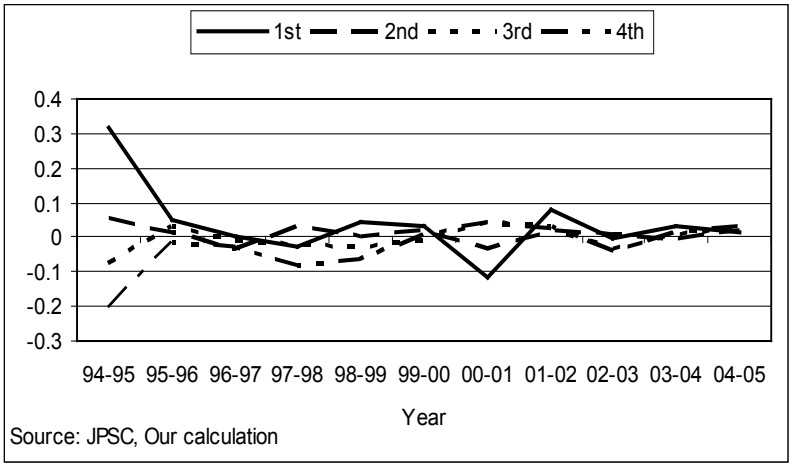

Figure 1.27 Directional Movement by Quartile in Base Year

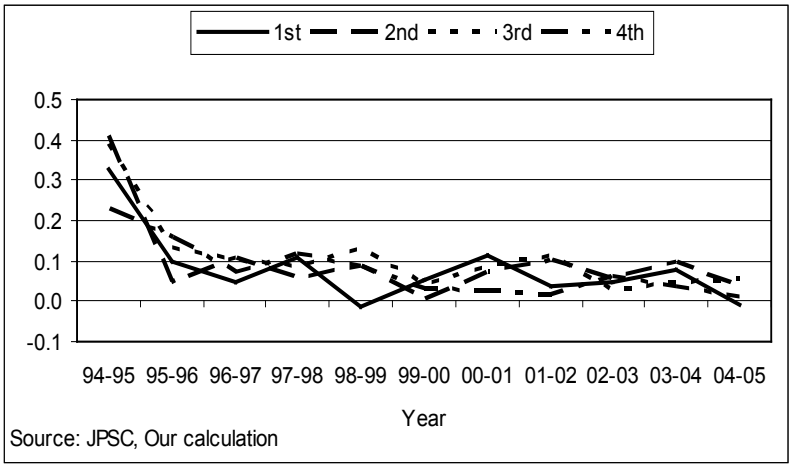

Figure 1.28 Equalizer for a Long-term Income by Quartile

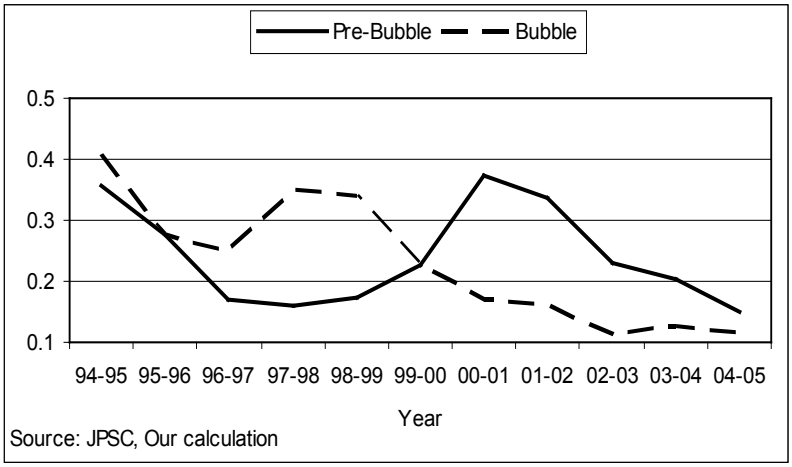

Figure 1.29 Time Dependence by Cohort

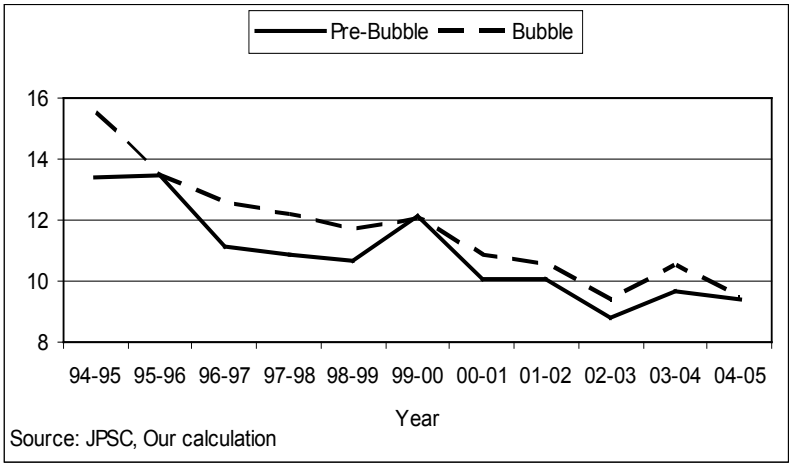

Figure 1.30 Positional Movement by Cohort

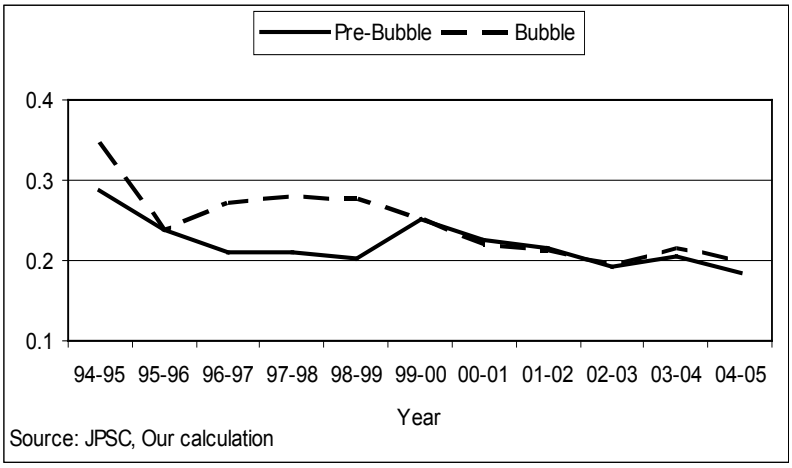

Figure 1.31 Share Movement by Cohort

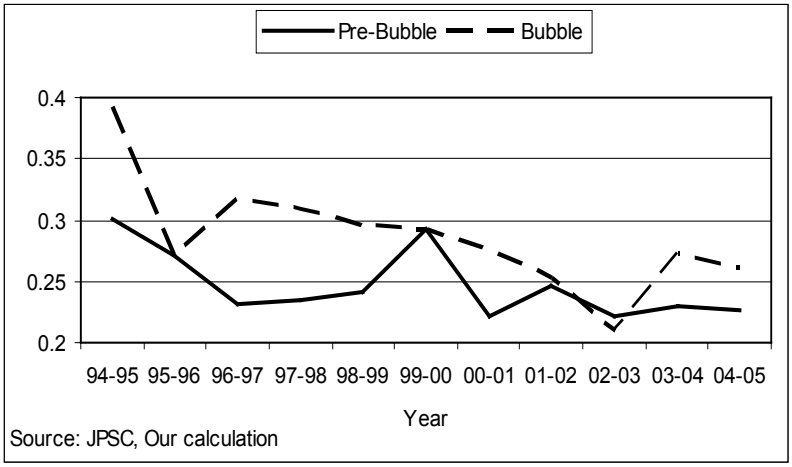

Figure 1.32 Non-directional Movement by Cohort

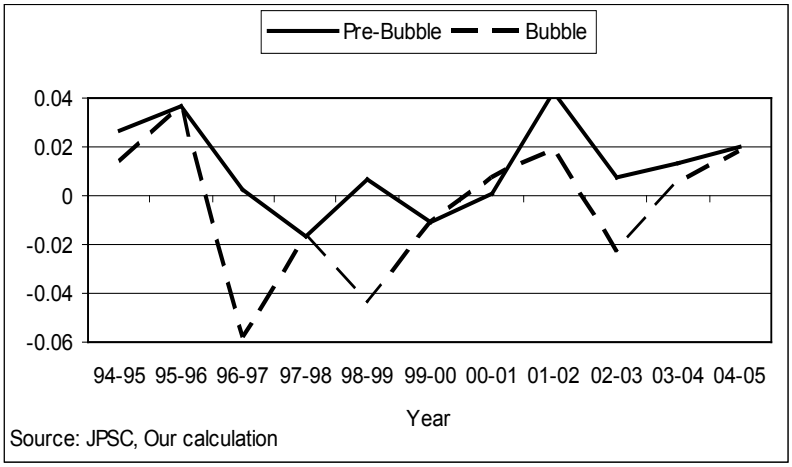

Figure 1.33 Directional Movement by Cohort

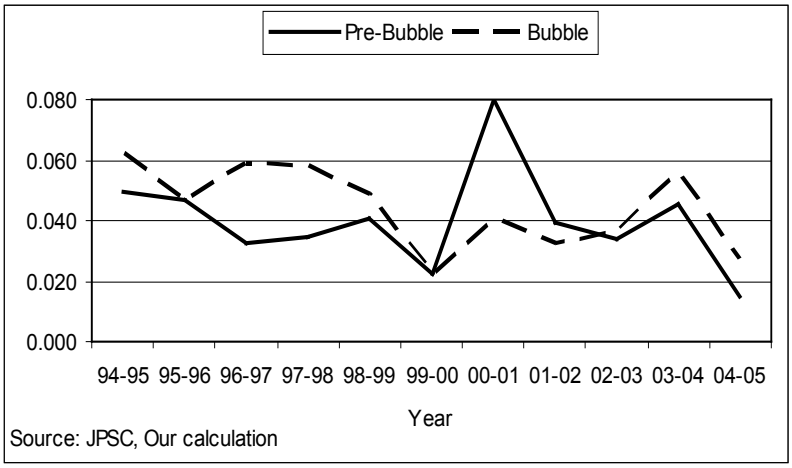

Figure 1.34 Equalizer for a long-term Income

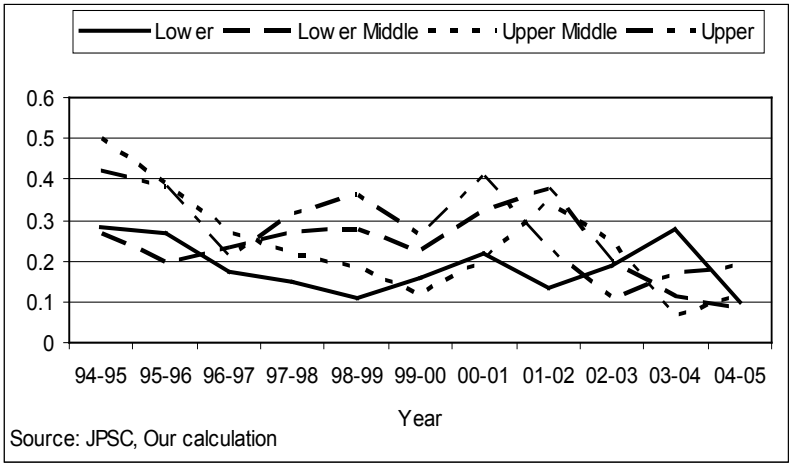

Figure 1.35 Time Dependence by Parent's Income

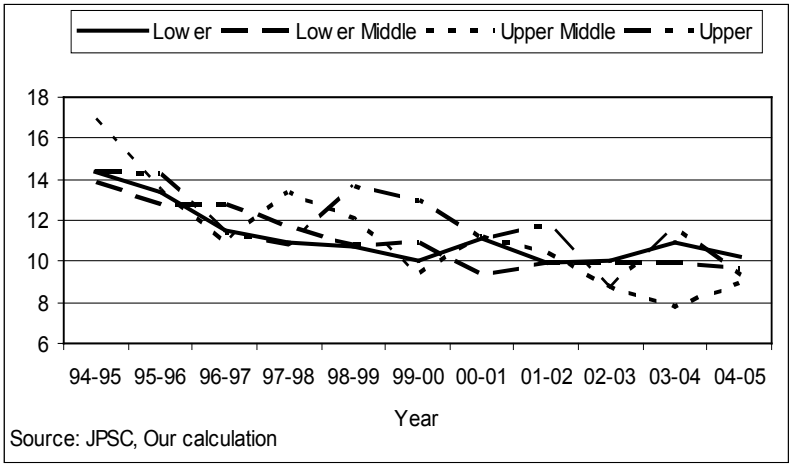

Figure 1.36 Positional Movement by Parent's Income

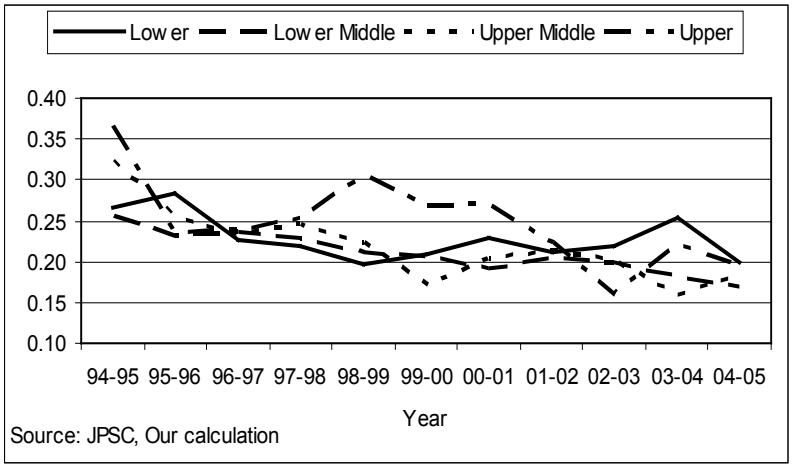

Figure 1.37 Share Movement by Parent's Income

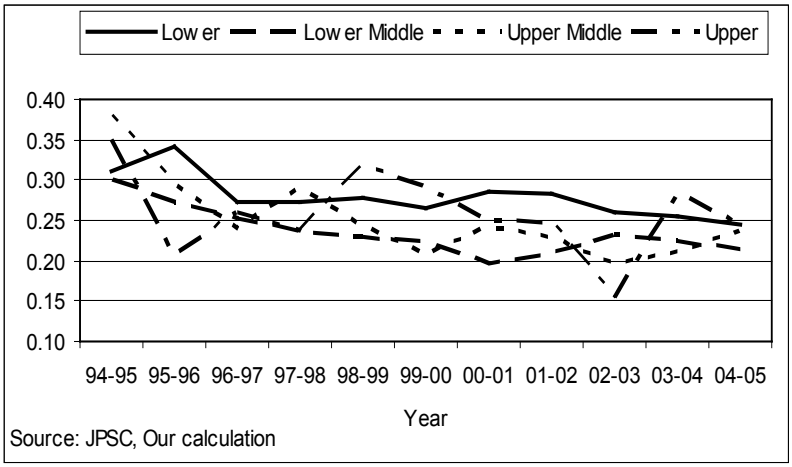

Figure 1.38 Non-directional Movement by Parent's Income

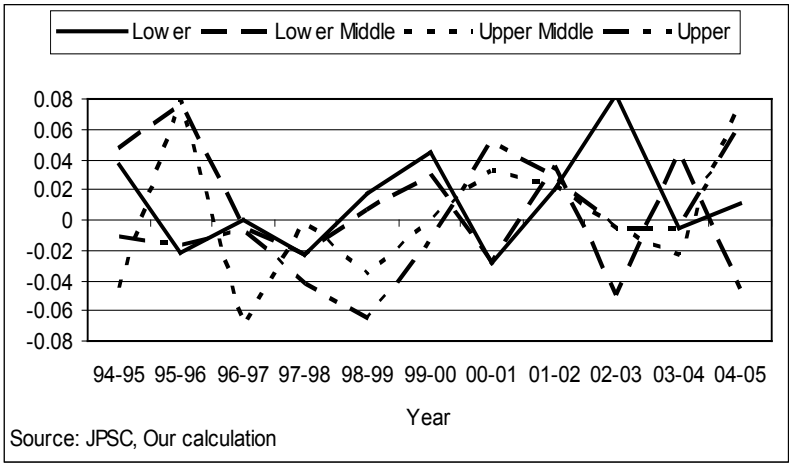

Figure 1.39 Directional Movement by Parent's Income

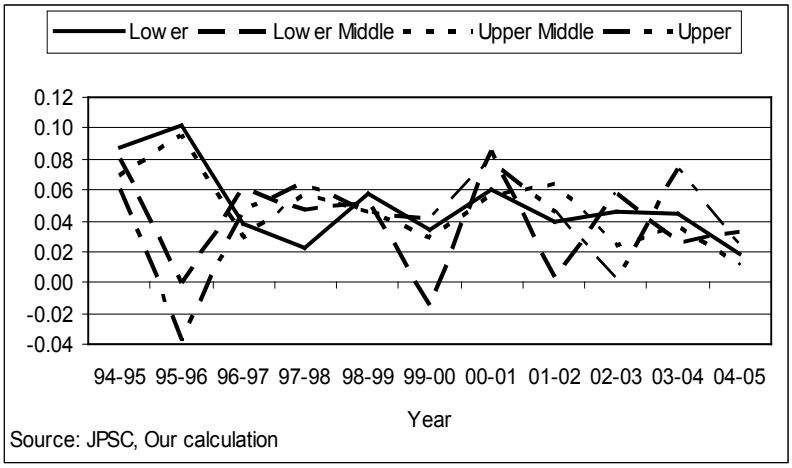

Figure 1.40 Equalizer for a Long-term Income by Parent's Income

4.2 3-year Income Mobility

Tables 1.4-1.6 show the 3-year macro income mobility. Time dependence mobility and mobility as an equalizer of long-term incomes have the maximum value in 1998-2001 and the minimum value in 2002-2005. Thus, according to these measurements, first the mobility-as-time-dependence and mobility as an equalizer of long-term incomes increased in 1998-2001, and then decreased in 2002-2005.

On the other hand, the values of positional movement, share movement and non-directional income movement decreased from 1994-1997 to 2002-2005. This means that the income mobility in terms of percentile rank, income share and absolute value change went down over 12 years.

As for directional income movement, the value went down for 1998-2001 and then went up for 2002-2005. This might be because during 1998-2002 more people experienced an income decrease compared with the other two periods.

By education, in time dependence, technical college, junior college, and university graduates have the lease mobility for 2002-2005, but high school graduates have the highest mobility for 2002-2005. In positional movement, the mobility of all groups dropped from 1994-1997 to 2002-2005. In share movement and non-directional movement, all groups had less mobility for 2002-2005 than for 1994-1997 but the paths of decline are different. Only high school graduates have positive value in directional movement in all three periods, in contrast, other groups had at least one negative value.

By quartile of initial income in base year, the mobility of1st, 2nd, and 4th quartile declined over the three periods but 3rd quartile had higher mobility in 2002-2005 than in 1998-2001. In positional movement, all groups decrease their mobility. The mobility did not change so much in share movement and non-directional movement for all groups. In directional movement, 1st and 2nd quartile had positive values, and 3rd and 4th quartile had negative values throughout the survey periods. The value of the equalizer for a long-term inequality went down from 199401997 to 2002-2005 for all groups.

By cohort, in time dependence, share movement and non-directional movement, for the bubble cohort, their mobility decreased over the three

periods and for the pre-bubble cohort, first the mobility increased from 1994-1997 to 1998-2001, and then the mobility declined. In share movement, for both cohorts, mobility throughout the three periods reduced. In directional movement, the pre- bubble cohort had all positive values, whereas the bubble cohort had all negative values. Equalizer for a long-term mobility had stable movement for both cohorts. There was no significant difference in the mobility pattern between the pre-bubble and the bubble cohort as a whole.

By parent's income level, in almost all measurements except directional movements, the mobility declined over three periods for each group. Under these circumstances, the lower middle and upper middle groups had higher mobility than others in almost all measurements. The lower group had the least mobility except directional movement.

Table 1.4 3-year Income Mobility by Entire Sample in JPSC

Period	Time Dependence	Positional movement	Share movement	Non-directional movement	Directional movement	Mobility as an equalizer
1994-1997	0.368	16.496	0.350	0.381	0.017	0.061
1998-2001	0.446	15.422	0.335	0.349	0.011	0.085
2002-2005	0.273	13.456	0.280	0.319	0.013	0.056

Table 1.5 3-year Income Mobility by Education

Group	Period	Time Dependence	Positional movement	Share movement	Non-directional movement	Directional movement	Mobility as an equalizer
High School	1994-1997	0.423	17.840	0.339	0.368	0.009	0.061
	1998-2001	0.316	14.749	0.284	0.313	0.020	0.058
	2002-2005	0.432	13.682	0.306	0.331	0.003	0.052
Tech College	1994-1997	0.276	15.114	0.301	0.369	0.008	0.079
	1998-2001	0.467	14.700	0.326	0.311	-0.011	-0.013
	2002-2005	0.168	11.809	0.224	0.269	0.056	0.053
Junior College	1994-1997	0.398	16.795	0.349	0.377	-0.019	0.063
	1998-2001	0.491	14.515	0.338	0.298	0.036	0.152
	2002-2005	0.226	14.366	0.248	0.310	0.049	0.076
University	1994-1997	0.417	20.380	0.423	0.446	0.118	0.045
	1998-2001	0.242	14.378	0.294	0.318	-0.009	0.073
	2002-2005	0.157	11.265	0.225	0.261	-0.005	0.070

Table 1.6 3-year Income Mobility by Quartile in Base Year

Group	Period	Time Dependence	Positional movement	Share movement	Non-directional movement	Directional movement	Mobility as an equalizer
1st	1994-1997	1.000	27.307	0.437	0.522	0.348	0.311
	1998-2001	0.641	16.445	0.349	0.325	0.035	0.012
	2002-2005	0.263	14.018	0.263	0.289	0.063	0.058
2nd	1994-1997	0.790	26.730	0.292	0.311	0.009	0.416
	1998-2001	0.484	18.147	0.264	0.272	0.015	0.082
	2002-2005	0.476	16.165	0.279	0.321	0.014	0.096
3rd	1994-1997	0.737	26.588	0.298	0.307	-0.059	0.416
	1998-2001	0.362	17.316	0.259	0.281	-0.024	0.139
	2002-2005	0.487	13.770	0.269	0.293	-0.002	0.083
4th	1994-1997	0.567	25.577	0.349	0.389	-0.234	0.291
	1998-2001	0.530	17.988	0.349	0.369	-0.012	0.156
	2002-2005	0.218	11.776	0.242	0.279	-0.032	0.086

Table 1.7 3-year Income Mobility by Cohort

Group	Period	Time Dependence	Positional movement	Share movement	Non-directional movement	Directional movement	Mobility as an equalizer
Pre-Bubble	1994-1997	0.307	15.700	0.313	0.341	0.042	0.046
	1998-2001	0.403	13.212	0.280	0.282	0.044	0.087
	2002-2005	0.316	12.330	0.268	0.305	0.045	0.039
Bubble	1994-1997	0.463	18.022	0.397	0.446	-0.025	0.090
	1998-2001	0.418	14.669	0.341	0.355	-0.037	0.035
	2002-2005	0.167	12.598	0.253	0.307	-0.015	0.080

Table 1.8 3-year Income Mobility by Parent's Income

Group	Period	Time Dependence	Positional movement	Share movement	Non-directional movement	Directional movement	Mobility as an equalizer
Lower	1994-1997	0.266	14.830	0.286	0.326	0.051	0.086
	1998-2001	0.176	13.073	0.259	0.312	0.066	0.076
	2002-2005	0.180	12.842	0.262	0.314	0.078	0.045
Lower Middle	1994-1997	0.348	17.517	0.320	0.363	0.050	0.104
	1998-2001	0.405	12.063	0.276	0.253	-0.002	0.053
	2002-2005	0.266	13.032	0.249	0.295	-0.060	0.072
Upper Middle	1994-1997	0.552	19.920	0.399	0.440	-0.059	0.099
	1998-2001	0.334	17.388	0.298	0.351	0.008	0.094
	2002-2005	0.367	12.465	0.286	0.289	0.024	0.060
Upper	1994-1997	0.390	15.746	0.363	0.371	-0.036	0.060
	1998-2001	0.594	15.705	0.377	0.337	-0.023	0.076
	2002-2005	0.265	12.459	0.254	0.291	0.031	0.053

4.3 11-year Income Mobility

Table 1.9 shows 11-year income mobility. These results show a trend over the whole period of the survey from 1994 to 2005. Time dependence had the value of 0.579. Compared with the shorter-term values, this result indicates that the longer the period was, the larger the income mobility in Japan was. Then, positional movement also shows that more people experienced positional movement in 11 years than in 3 years or in 1 year. The value of share movement had the value of 0.479. This movement suggests the frequency and magnitude of the household share changes got larger as the length of the period became longer.

Non-directional income movement, 0.522, gauges the extent of fluctuation in the incomes of households. Compared with the value of directional income movement which measures the direction of the income change as well as their amounts, 0.019, the result indicates that some people experienced upward fluctuation and others faced downward movement. However, as a whole society, positive mobility was a little larger than negative over these 11 years.

Mobility as an equalizer of long-term incomes, 0.125, considers how the income changes experienced by households caused the inequality of longer-term incomes to differ from the inequality of the base-year incomes. According to this measurement, Japanese society had more inequality in 2005 than in 1994. This result reaches the same conclusion as the previous studies.

From these results, it can be said that some households experienced upward changes whereas others encountered downward movements of income per capita both in their percentile rank and in the real-term value from

1994 to 2005. Therefore, in the end, the overall inequality in Japanese society worsened over 12 years.

Next, the 11-year mobility by categories is discussed. By education, there is no specific group which had distinct values from the other groups. High school graduates and junior college graduates, which consist of the majority of the sample, experienced more time dependence mobility and less positional movement and share movement compared with the other two groups. Thus, the value of household income per capita changed by relatively large amount but it did not necessarily lead to position or share within the groups. On the other hand, technical college graduates and university graduates did not experience the value change in household income per capita but their position or share moved within their groups.

By quartile of initial household income in the base year, in general, their values in six measurements were larger than those by the other categories. It means that the mobility within a group was higher categorized by initial income in the base year. Among these groups, the second quartile group had less mobility than the others. By cohort, the bubble cohort had higher mobility than the pre-bubble cohort in all six measurements. The bubble cohort might have more choices than the pre-bubble cohort regarding their life styles.

By parent's income level, the upper group was more mobile than the other groups, and the lower group had the least mobility in most measurements. This means that if parents have high income, daughters encounter a variety of opportunities in their life, which causes the larger mobility within the group. On the other hand, if their parents are not so rich, the options for their daughters are limited and their household incomes do not change so frequently.

Table 1.9 11-year Income Mobility

Group	Time Dependence	Positional movement	Share movement	Non-directional movement	Directional movement	Mobility as an equalizer
Entire Sample	0.579	22.811	0.479	0.522	0.019	0.125
By Education						
High School	0.654	22.604	0.451	0.490	0.023	0.150
Tech College	0.571	25.949	0.512	0.573	-0.012	0.156
Junior College	0.605	23.590	0.456	0.509	0.016	0.110
University	0.646	24.847	0.527	0.575	0.055	0.132
By Quartile						
1st	0.874	28.749	0.461	0.615	0.441	0.305
2nd	0.853	29.415	0.359	0.428	0.106	0.412
3rd	0.931	31.855	0.410	0.450	-0.117	0.464
4th	0.870	31.407	0.486	0.596	-0.397	0.422
By Cohort						
Pre-Bubble	0.506	21.025	0.423	0.478	0.118	0.103
Bubble	0.640	24.464	0.543	0.590	-0.139	0.163
By Parent's income						
Lower	0.423	20.095	0.401	0.465	0.183	0.147
Lower Middle	0.459	23.398	0.424	0.499	-0.017	0.151
Upper Middle	0.664	24.359	0.487	0.502	-0.048	0.193
Upper	0.710	26.687	0.543	0.603	-0.096	0.146

In conclusion, at the macro level, the household income per capita mobility became lower in the long-run as a whole. The structure of the labor market changed and more and more people had jobs as non-regular staff. The non-regular staff wage had been stable but when the economy seemed good, the companies hired many non-regular staff. However, once the economy seemed to turn bad, they could easily reduce the number of non-regular staff, which reflected the change in unemployment rate. Thus, when the change in GDP growth rate was large, the income of household who had non-regular staff may have fluctuated. According to Wakita (2006), the labor market in Japan is not fluid even among regular staff or among non-regular staff, so the liquidity between regular and non-regular staff is especially low. Wakita further states there exists a hug gap in their wage between regular and non-regular staff. In this research groups, even if the income of households who had non-regular staff changes following GDP growth, the percentile rank and share movement might not change so much. Since the number of non-regular staff had gone up, the inequality in Japanese society would probably get worse in the future.

When the macro mobility is observed by some categories, various aspects of mobility are captured. By education, the groups of people who had higher education had more mobility in household income within a group than people who had lower education. Similarly, the household income of the people whose parents earned higher incomes fluctuated more within the group than those whose parents earned lower wages. This indicates that when people have more choices regarding their life style, the income within those groups has more dynamism compared with the group of people who has limited alternatives. Also, the same principle can be applied to the macro

mobility by cohort. People who started their career before the bubble economy had less choices regarding their career than people found their jobs under the bubble economy. Thus, the bubble cohort had more mobility on their household income than the pre-bubble cohort.

As for the quartile of initial income there was no significant difference in household income per capita across their groups. All groups had high mobility than other categories. It might be a fact that the initial income of the samples did not represent the characteristics to decide future household income per capita. This is because the samples were women who were in their 20s in base year. Since the people who had lower education started their jobs earlier than those who had higher education, their wages in their 20s might be higher or equal to higher educated people. However, usually the wages of higher educated people exceed lower educated people's wages in their 30s. Consequently, in this case, initial wages in their 20s might not be a good indicator to capture the factors which decide the difference in their future income.

5. Micro Household Income per Capita Mobility

In this section, the results of unconditional and conditional household income mobility are examined. Micro mobility focuses on the mobility of the individual and answers the question: which individuals moved up/down in the earnings distribution over time and by how much? To begin answering this question, mobility profiles are presented which show the mean and the standard deviation of one-year household income changes for the different subgroups of individuals. These statistics for individuals are broken down by education, initial income quartile, cohort and parent's income level. First, the

unconditional mobility indicates to what extent there is convergence between the incomes of the rich and the poor over time. Then, the conditional mobility explores that if conditional convergence level exists, how soon household incomes converge to their predicted level depending on a set of observable and unobservable characteristics. The conditional mobility models are used to study the correlation of the household income changes while holding other variables constant. The model in this study specifies the income changes as a function of initial household income, cohort, education, parent's income level, marital status, the number of family members, employment status, living area, living condition in terms of the relationship with their parents, housing ownership, and age. The results are not interpreted as a causal model of household income changes, but rather a way of answering the question of which individuals experience the most positive income changes, holding other things equal.

5.1 Micro Mobility Profile Results

Table 1.10-1.14 show the results of micro mobility profile in the Japanese Yen from 1994-2005 including cohort A, from 1997-2005 including cohort A and B, and from 2003-2005 including cohort A, B, and C respectively. As a whole, the mean of the one-year income change is very small compared with their total household income per capita. This is caused by the low GDP growth rate over this period. On the other hand, the standard deviation of one-year household income change is large. Thus, the individual level of mobility seems distributed on broad range.

In table 1.10, the 4th quartile experienced a larger household income change than other quartiles. Also, the bubble cohort had larger standard

deviation than the pre-bubble cohort. By education, it is recognized that the higher educated people had larger standard deviation of household income mobility although their mean was not much different among education level. By parent's income level, the standard deviation was larger as their parents' income level was higher, but the mean of the one-year household income change was lower as their parents got higher incomes. According to table 5.2.1, inequality of mean household income across groups within categories from 1994-2005 was largest for initial household income quartile and the smallest for education.

Next, in table 1.12, by initial income quartile, the same trend as table 1.10 is observed. By cohort, the standard deviation of the pre-bubble cohort increased although the one of the bubble cohort decreased. By education and by parent's income level, the same trends as table 1.10 are recognized; the higher educated people had a larger standard deviation of the household income mobility, and the standard deviation was larger as their parents income level got higher. According to table 1.13, inequality of mean household income across groups within categories was the largest for initial household income quartile and the smallest for education and parent's income level.

In table 1.14, by initial income quartile, the higher initial household income quartile had a lower mean one-year household income change and larger standard deviation. By cohort, cohort C had the largest standard deviation and the pre-bubble cohort and the bubble cohort had less standard deviation than table 1.10 and 1.12 By education, higher educated people had the larger standard deviation and by parent's income level the standard deviation was larger as their parents income level got higher. According to table 1.15, inequality of mean household income across groups within

categories was the largest for initial household income quartile and the smallest for cohort.

Therefore, according to the micro mobility profile results, people whose initial household income quartile was higher tended to have lower mean and higher standard deviation of one-year household income change. By cohort, the cohort composed of younger people had a higher standard deviation of one-year income change. Also, the standard deviation of the higher educated people tended to be larger, and as parent's income level got higher, people's one-year household income change became larger.

Table 1.10 Micro Mobility Profile for One-year Household Income Change in the Japanese Yen from 1994-2005 (Cohort A)

	Observation	Mean	S.D.	Min	Max
Total sample	9646	0.888	98.528	-1791.334	2426.385
By Initial Income in 1994					
Quartile1	2288	5.900	74.115	-1791.334	1774.508
Quartile2	2412	3.255	76.508	-990.345	1240.595
Quartile3	2552	1.520	82.587	-983.585	1008.055
Quartile4	2394	-6.960	143.588	-1680.448	2426.385
By Cohort					
Pre-Bubble	5919	2.252	94.795	-1680.448	2426.385
Bubble	3727	-1.278	104.158	-1791.334	1774.508
By Education					
High School	4321	0.843	76.783	-990.345	1008.055
Tech College	1941	0.877	108.521	-1791.334	1774.508
Junior College	2036	0.325	111.566	-1680.448	2426.385
University	1296	2.079	123.653	-1507.340	1409.248
By Parent's Income					
Lower	2489	3.639	70.291	-990.345	880.059
Lower Middle	2944	0.575	82.248	-1680.448	1651.180
Upper Middle	1936	-0.170	85.625	-983.585	1008.055
Upper	2277	-0.813	144.031	-1791.334	2426.385

Table 1.11 Inequality of Mean Household Income across Groups within Categories from 1994-2005 (Cohort A)

	Inequality of Income Changes across Groups within Categories
Initial Income	4.770
Cohort	1.765
Education	0.524
Parent's Income	1.702

Table 1.12 Micro Mobility Profile for One-year Household Income Change in the Japanese Yen from 1997-2005 (Cohort A & B)

	Observation	Mean	S.D.	Min	Max
Total sample	6536	2.822	101.029	-1680.448	2426.385
By Initial Income in 1997					
Quartile1	1512	8.209	94.332	-1676.581	1859.931
Quartile2	1644	2.866	54.275	-409.365	587.342
Quartile3	1731	4.488	88.258	-983.585	1008.055
Quartile4	1649	-3.912	145.351	-1680.448	2426.385
By Cohort					
Pre-Bubble	903	4.064	148.614	-1676.581	1859.931
Bubble	1813	-1.215	89.860	-939.728	647.082
Cohort B	3820	4.444	91.691	-1680.448	2426.385
By Education					
High School	2967	2.365	74.952	-983.585	1008.055
Tech College	1253	2.349	95.172	-777.929	1561.014
Junior College	1408	4.359	138.405	-1680.448	2426.385
University	880	3.133	114.321	-1053.152	1084.061
By Parent's Income					
Lower	2398	2.806	69.143	-777.929	623.131
Lower Middle	1989	2.704	61.222	-458.939	419.390
Upper Middle	1152	3.026	125.750	-1680.448	1651.180
Upper	997	2.857	172.363	-1676.581	2426.385

Table 1.13 Inequality of Mean Household Income across Groups within Categories from 1997-2005 (Cohort B)

	Inequality of Income Changes across Groups within Categories
Initial Income	4.740
Cohort	3.423
Education	2.035
Parent's Income	2.017

Table 1.14 Micro Mobility Profile for One-year Household Income Change in the Japanese Yen from 2003-2005 (Cohort A & B &C)

	Observation	Mean	S.D.	Min	Max
Total sample	3193	3.418	100.204	-1661.675	888.613
By Initial Income in 2003					
Quartile1	772	19.980	68.162	-459.122	499.502
Quartile2	803	8.778	70.386	-409.365	888.613
Quartile3	827	2.426	77.526	-369.083	522.119
Quartile4	791	-17.149	154.920	-1661.675	786.369
By Cohort					
Pre-Bubble	925	2.536	81.107	-990.345	869.784
Bubble	590	3.594	70.598	-459.122	499.502
Cohort B	529	2.260	91.903	-611.390	737.665
Cohort C	1149	4.571	127.197	-1661.675	888.613
By Education					
High School	1332	4.070	83.290	-990.345	869.784
Tech College	611	1.834	86.075	-494.257	737.665
Junior College	704	7.922	103.180	-459.541	888.613
University	532	0.426	122.465	-1137.448	596.072
By Parent's Income					
Lower	1153	2.101	77.272	-990.345	737.665
Lower Middle	951	4.811	93.757	-1661.675	769.399
Upper Middle	482	6.828	101.315	-542.605	869.784
Upper	607	1.031	139.958	-1137.448	888.613

Table 1.15 Inequality of Mean Household Income across Groups within Categories from 2003-2005 (Cohort A & B & C)

	Inequality of Income Changes across Groups within Categories
Initial Income	13.594
Cohort	1.732
Education	3.818
Parent's Income	3.295

5.2 Unconditional Household Income per Capita Mobility

The model of unconditional household income mobility is as follows:

$$\Delta Y_{i,t} = \alpha + \beta Y_{i,t-1} + u_{i,t}$$

$Y_{i,t}$ =Household income per capita

Table 1.16-1.18 represents the results of the regression with unconditional household income mobility model from 1994-2005 including cohort A, from 1997-2005 including cohort A and B, and from 2003-2005 including cohort A, B, and C respectively. According to the Durbin Watson test, the models did not have serial correlation. Since it is likely that there existed attrition bias in the household incomes, the robust model is compared with the one adjusted by the inverse probability weighting method (IWP).

In all of these models, β took negative values and they were all significant at the 1 % significance level. The values of the coefficients and constants between the model with and without IPW were very close in table 1.16 and 1.17, but there was some difference in table 1.18. This might be because cohort A and B did not have any serious attrition bias to affect the regression but the attrition bias of cohort C was relatively strong although they participated in the survey for a short time.

The results of these models indicate that there is convergence between the household incomes of the initially rich and the initially poor households. This shows the possibility for equality of opportunity in Japanese society.

Table 1.16 Results for One-year Household Income Change with Unconditional Mobility Model from 1994-2005 (Cohort A)

Variable	One-year income change		One-year income change with IPW	
Lagged income	-0.252	0.028***	-0.255	0.028***
Constant	49.732	4.996***	48.958	4.836***
N		9646		9594
R2		0.120		0.121
Root MSE		92.458		89.833

Table 1.17 Results for One-year Household Income Change with Unconditional Mobility Model from 1997-2005 (Cohort A & B)

Variable	One-year income change		One-year income change with IPW	
Lagged income	-0.219	0.034***	-0.227	0.038***
Constant	45.503	6.195***	45.354	6.535***
N		6536		6508
R2		0.082		0.086
Root MSE		96.787		91.734

Table 1.18 Results for One-year Household Income Change with Unconditional Mobility Model from 2003-2005 (Cohort A & B & C)

Variable	One-year income change		One-year income change with IPW	
Lagged income	-0.254	0.043***	-0.197	0.025***
Constant	54.754	8.058***	41.056	4.132***
N		3193		3179
R2		0.124		0.081
Root MSE		93.793		80.223

* Significant at 10% level

** Significant at 5% level

***Significant at 1 % level

5.3 Conditional Household Income per capita Mobility

In the conditional income mobility model, the coefficients did not capture the extent to which the initially poorer households caught up with the initially richer ones. Instead it estimated the extent to which the poorer and the richer households who were observationally equivalent in terms of some characteristics such as education had the income patterns that converged over time.

First, I checked the relationship between the one-year household incomes per capita change and time-invariant variables. The conditional household income mobility model, which is employed with time-invariant variables, is as follows:

$$\Delta Y_{i,t} = \alpha + \beta_1 Y_{i,t-1} + \beta_3 Z_i + \varepsilon_{i,t}$$

$Y_{i,t}$ =Household income per capita in year t

Z_i =Initial household income per capita quartile dummy, Cohort dummy, Education dummy, and Parent's income level dummy

Table 1.19-1.21 represents the results of regression with the time-invariant variables from 1994-2005 including cohort A, from 1997-2005 including cohort A and B, and from 2003-2005 including cohort A, B, and C respectively.

In all cases, β_1 had negative values and they were all significant at the 1 % significance level. This indicates that there was convergence between the household incomes of the initially rich and the initially poor households. In addition, the coefficients of the initial household income quartile dummy variables had positive signs in all cases and it seems that people who had

higher initial household income had larger positive one-year household income per capita change. Regarding the education dummy variables, it can be said that the higher educated people experienced larger positive household income changes. The coefficients of the cohort dummy and the parent's income level were not significant in most cases and some specific trends were not observed from these results.

Table 1.19 Results for One-year Household Income Change with Time-invariant Variables from 1994-2005 (Cohort A)

Variable	One-year income change		One-year income change with IPW	
Lagged income	-0.354	0.034***	-0.358	0.034***
2nd Quartile	8.348	2.418***	8.413	2.389***
3rd Quartile	21.489	3.578***	21.594	3.570***
4th Quartile	52.509	6.852***	52.518	6.892***
Cohort A2 (Bubble)	-3.806	2.022*	-3.704	1.907*
Tech college	6.544	2.522***	6.349	2.470**
Junior college	5.481	2.423**	5.555	2.293*
University	30.022	3.972***	29.800	3.907***
Lower middle parent's wage	-1.756	1.949	-1.206	1.870
Upper middle parent's wage	-5.650	2.406**	-4.608	2.300**
Upper parent's wage	1.208	3.102	2.443	3.027
Constant	44.916	3.886***	44.987	3.870***
N		9594		9594
R2		0.159		0.161
Root MSE		90.570		87.819

Table 1.20 Micro Mobility Results for One-year Household Income Change with Time-invariant Variables from 1997-2005 (Cohort A & B)

Variable	One-year income change		One-year income change with IPW	
Lagged income	-0.356	0.048***	-0.375	0.052***
2nd Quartile	5.063	3.311	6.161	2.951**
3rd Quartile	26.629	5.782***	29.204	5.609***
4th Quartile	60.842	11.100***	67.271	11.183***
Cohort A2 (Bubble)	-7.845	5.008	-8.429	4.954*
Cohort B	2.774	4.934	1.156	4.917
Tech college	2.647	2.919	1.398	2.649
Junior college	5.222	3.321	3.854	3.008
University	21.485	4.827***	19.863	4.663***
Lower middle parent's wage	2.346	2.022	2.098	1.874
Upper middle parent's wage	3.572	3.572	3.212	3.440
Upper parent's wage	13.537	5.259**	13.413	5.074***
Constant	41.332	6.714***	44.480	7.231***
N		6508		6508
R2		0.126		0.135
Root MSE		94.562		89.320

Table 1.21 Micro Mobility Results for One-year Household Income Change with Time-invariant Variables from 2003-2005 (Cohort A & B &C)

Variable	One-year income change		One-year income change with IPW	
Lagged income	-0.381	0.053***	-0.363	0.048***
2nd Quartile	7.399	4.382*	9.511	4.275**
3rd Quartile	23.251	7.006***	27.336	6.609***
4th Quartile	62.433	13.749***	64.146	12.829***
Cohort A2 (Bubble)	-0.733	3.811	-2.616	3.658
Cohort B	-5.516	4.646	-6.093	4.219
Cohort C	-1.844	4.236	1.934	4.554
Tech college	2.976	3.908	0.317	3.524
Junior college	8.223	4.292*	2.556	3.654
University	20.466	5.515**	15.322	5.308***
Lower middle parent's wage	8.531	3.313***	9.963	2.889***
Upper middle parent's wage	9.748	5.407*	13.338	6.095**
Upper parent's wage	12.177	5.773**	14.650	5.943**
Constant	46.868	5.292***	42.204	4.364***
N		3179		3179
R2		0.136		0.121
Root MSE		89.294		78.610

* Significant at 10% level

** Significant at 5% level

***Significant at 1 % level

The model of conditional household income mobility including time-variant variables is as follows:

$$\Delta Y_{i,t} = \alpha + \beta_1 Y_{i,t-1} + \beta_2 \Delta X_{i,t} + \beta_3 Z_i + \varepsilon_{i,t}$$

$Y_{i,t}$ =Household income per capita in time t

$X_{i,t}$ =Marital status dummy, Number of family members, Employment status dummy, Region dummy, Living condition dummy, and Housing ownership dummy in time t

Z_i = Initial household income per capita quartile dummy, Cohort dummy, Education dummy, Parent's income level dummy, Age, and Age-squared

This model includes several additional dummy variables and table 1.22 explains their characteristics.

Table 1.23-1.25 represents the results of regression with the time-invariant variables from 1994-2005 including cohort A, from 1997-2005 including cohort A and B, and from 2003-2005 including cohort A, B, and C respectively. According to the Durbin Watson test, the models did not have serial correlation. Since it is likely that there existed the attrition bias in the household incomes, the robust model was compared with the one adjusted by the inverse probability weighting method (IWP).

In all cases, β_1 had negative values and they were all significant at the 1 % significance level. This indicates that there was convergence between the

household incomes of the initially rich and the initially poor households. Regarding the initial household income quartile dummy variables and education dummy variables, the same pattern as the previous model could be observed; the people who had higher initial household income had larger positive one-year household income per capita change and the higher educated people experienced larger positive household income change. The coefficients of cohort dummy and parent's income level are not significant in most cases and some specific trends were not observed from these results, either.

When women got married or married couples started to live with husband's parents, the household income per capita experienced positive change. However, when the number of family member increased, their household income per capita decreased. This makes sense because in general, their husbands or parents have higher income than the samples. Thus, if they live with the people who have higher income, their household income per capita goes up. On the other hand, when they give birth to a baby, they have more dependents, which leads to a decline in household income per capita. The change of employment status did not have a strong impact on the household income per capita against logic. This might be because in Japan, women are engaged in their jobs only when their husbands' wages decrease and they need to make up for the loss. After they start to work, their wage brings additional income into their households but at the same time, the decreases in their husbands' wages have a negative effect, so both canceled each other out. The changes in living place and in housing ownership did not have a specific effect on the one-year household income per capita change.

Age and age-squared had significant coefficients and considering realistic cases, it means that as people got older at the early stage of their lives, the one-year household income change dropped perhaps because they had more dependents with having children. Then after passing a certain age, their children left their houses and the number of dependents fell, which caused the increase in household income per capita.

Micro mobility profiles show that people whose initial household income quartile was higher tend to have lower mean and higher standard deviation of one-year household income change. By cohort, the cohort composed of younger people had a higher standard deviation of one-year income change. Also, the standard deviation of the higher educated people tended to be larger, and as parent's income level climbed, people's one-year household income change became larger. The unconditional micro income mobility indicates that it is possible that the poorer people would catch up with the richer people. Then, the conditional micro income mobility also indicates that there existed conditional convergence. People who had higher initial incomes or a higher education had larger positive changes in their one-year household incomes. Also, when the people started to live with others who had higher wages, their one-year household income changes went up. On the other hand, the increase in the number of dependents reduced the household income per capita.

Table 1.22 Dummy Variables

Dummy Variable	1	0
Marital status	Married	Not married
Employment status	Employed	Unemployed
Region	Living in urban area	Living in rural area
Living condition	Living with parents	Living separately from parents
Housing ownership	Owning house	Not owning house

Table 1.23 Results for One-year Household Income Change from 1994-2005 (Cohort A)

Variable	One-year income change		One-year income change with IPW	
Lagged income	-0.364	0.034***	-0.368	0.034***
2nd Quartile	8.886	2.404***	8.980	2.372***
3rd Quartile	23.000	3.570***	23.104	3.560***
4th Quartile	53.995	6.869***	53.946	6.907***
Cohort A2 (Bubble)	-5.229	2.186**	-5.327	2.047***
Tech college	5.316	2.468**	5.187	2.420**
Junior college	3.589	2.376	3.733	2.240*
University	29.623	3.822***	29.381	3.771***
Lower middle parent's wage	-1.035	1.906	-0.522	1.825
Upper middle parent's wage	-4.875	2.320**	-3.804	2.221*
Upper parent's wage	1.610	3.024	2.862	2.948
Marital status change	50.481	11.354***	51.341	10.603***
Family member change	-37.156	3.123***	-35.608	2.996***
Employment status change	-1.982	2.547	-1.521	2.363
Region change	13.738	12.665	10.967	11.339
Living condition change	39.889	9.592***	37.228	8.913***
Housing ownership change	11.506	10.377	10.667	9.277
Age	-10.504	2.896***	-10.569	2.780***
Age-squared	0.147	0.040***	0.148	0.038***
Constant	225.408	53.026***	227.442	50.923***
N		9491		9491
R2		0.202		0.204
Root MSE		87.954		85.302

Table 1.24 Micro Mobility Results for One-year Household Income Change from 1997-2005 (Cohort A & B)

Variable	One-year income change		One-year income change with IPW	
Lagged income	-0.3571	0.049***	-0.376	0.052***
2nd Quartile	5.8153	3.234*	6.693	2.891**
3rd Quartile	26.3847	5.809***	28.899	5.607***
4th Quartile	60.0549	11.174***	66.219	11.178***
Cohort A2 (Bubble)	-3.7913	4.973	-4.018	4.816
Cohort B	4.0795	6.205	3.357	5.704
Tech college	3.0693	2.828	1.695	2.568
Junior college	4.5843	3.241	3.186	2.941
University	21.2118	4.674***	19.724	4.527***
Lower middle parent's wage	1.9765	1.984	2.068	1.844
Upper middle parent's wage	2.2829	3.505	2.328	3.426
Upper parent's wage	12.5224	5.053**	12.956	4.894***
Marital status change	48.9947	13.553***	52.877	11.890***
Family member change	-43.2739	4.188***	-39.819	3.954***
Employment status change	-3.7665	3.268	-4.335	3.028
Region change	11.5609	9.658	7.661	7.415
Living condition change	30.4221	10.677***	26.446	9.863***
Housing ownership change	27.0364	13.486**	23.776	12.724*
Age	-8.5144	5.586	-8.764	5.031*
Age-squared	0.1184	0.072	0.122	0.065*
Constant	190.1867	104.640*	197.496	94.333**
N		6449		6449
R2		0.178		0.185
Root MSE		91.511		86.540

Table 1.25 Micro Mobility Results for One-year Household Income Change from 2003-2005 (Cohort A & B & C)

Variable	One-year income change		One-year income change with IPW	
Lagged income	-0.371	0.055***	-0.354	0.049***
2nd Quartile	6.374	4.368	8.759	4.138**
3rd Quartile	22.342	7.172***	25.740	6.632***
4th Quartile	58.925	14.265***	60.663	13.014***
Cohort A2 (Bubble)	5.388	5.862	3.414	5.435
Cohort B	4.496	9.158	1.361	8.707
Cohort C	4.928	13.832	1.443	13.346
Tech college	2.692	3.839	1.079	3.361
Junior college	6.588	4.213	1.187	3.349
University	20.416	5.326***	15.277	5.029***
Lower middle parent's wage	8.255	3.166***	9.434	2.763**
Upper middle parent's wage	6.950	5.190	9.287	5.381*
Upper parent's wage	11.421	5.543**	13.741	5.660**
Marital status change	38.963	13.824***	46.813	12.392***
Family member change	-34.313	5.500***	-34.669	7.726***
Employment status change	-4.458	4.895	-6.279	4.239
Region change	6.611	6.565	5.124	6.326
Living condition change	34.574	15.915**	25.264	16.146
Housing ownership change	25.130	13.548*	24.713	12.636*
Age	-6.014	6.102	-9.914	6.082
Age-squared	0.090	0.080	0.138	0.080*
Constant	138.872	118.024	212.800	116.702*
N		3149		3149
R2		0.179		0.182
Root MSE		86.620		75.422

* Significant at 10% level

** Significant at 5% level

***Significant at 1 % level

6. Conclusion

Household income per capita mobility is measured by the six different methods; mobility as time dependence, positional movement, share movement, non-directional movement, directional movement, and mobility as an equalizer of long-term incomes. The data set is from the Japanese Panel Survey of

Consumers (JPSC) conducted by the Institution for Research on Household Economics (IRHE). Although the samples were chosen randomly, the data set did not necessarily represent the whole Japanese society at that time. This is because the data set has three cohorts and the each cohort consists of young women only. The data is panel and it is likely to have attrition bias. In fact the household income per capita in cohort A is significantly different between the remaining samples and the attritors. Consequently, the inverse probability weighting (IPW) was used to adjust the bias from attrition.

At the macro level, the household income per capita mobility became lower in the long-run as a whole. The structure of labor market changed, and more and more people had been hired as non-regular staff. The non-regular staff wages had been stable but when the economy improved, the companies hired many non-regular staff. However, once the economy contracted, they could easily reduce the number of non-regular staff, which reflected the change in unemployment rate. Thus, when the change in GDP growth rate is large, the income of households who had non-regular staff may fluctuate.

When the macro mobility is observed by series of categories, various aspects of mobility are captured. By education, the groups of people who had higher education had more mobility in household incomes within a group than people who had lower education. Similarly, the household income of the people whose parents earned larger incomes fluctuates more within the group than those whose parents earned less wages. This indicates that when people had more choices regarding their life styles, the income within those groups had more dynamism compared with the group of people who had limited alternatives. Also, the same principle can be applied to the macro mobility by cohort. The people who started their career before the bubble economy had

less choices regarding their careers than the people who found their jobs during the bubble economy. Thus, the bubble cohort had more mobility on their household incomes than the pre-bubble cohort.

As for the quartile of initial incomes did not have significant difference in household income per capita across their groups. All groups had high mobility than other categories. This means that their future incomes could not be predicted based on their initial incomes. This is because the samples were women and in their 20s in the base year. Since the people who had a lower education started their jobs earlier than those who had a higher education, their wages in their 20s might be higher or equal to the higher educated people. However, usually the wages of higher educated people exceeds lower educated people's wages in their 30s. Consequently, in this case, the initial wages of people in their 20s might not be a good indicator to capture the factors to decide the difference in the future income.

Micro mobility profiles show that people whose initial household income quartile was higher tended to have a lower mean and a higher standard deviation of one-year household income changes. By cohort, the cohort composed of younger people had a higher standard deviation of one-year income change. Also, the standard deviation of the higher educated people tended to be larger, and as parent's income level got higher, people's one-year household income change became larger.

Unconditional micro income mobility indicates that it is possible for the poorer people to catch up with the richer people. Then, conditional micro income mobility also indicates that there existed conditional convergence. People who had higher initial income had larger positive changes in the one-year household. Also the higher educated people experienced a larger

increase in one-year household income per capita. When the people started to live with others who had higher wages; their husbands or their parents, the household income rose. On the other hand, the increase in the number of dependents reduced the household income per capita.

Therefore, at a macro level, the household income per capita mobility had been decreasing. However, from a micro point of view, some people who had some specific characteristics experienced expansion of their household income. Whereas, household income of others might decrease. Micro income mobility models also indicate that there existed conditional convergence.

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CHAPTER 2

HOUSEHOLD SAVING IN JAPAN

1. Introduction

It has been said that Japan's household savings provided the funds for investment that led to the high growth rate of its economy from the mid-1950s to mid-1970s. In fact, until the mid-1970s, the aggregate household saving rate in Japan had been increasing and reached 23 percent at its peak (Figure 2.1). This rate was very high when compared with other countries. Fumio Hayashi (1986), who analyzed this high saving rate in Japan, concluded that four main factors - insensitivity of the aggregate saving rate to demographics, the possibility of significant flow of intergeneration transfers, insignificance of the social security dummy, and prevalence of the extended family - led to the high household saving rate in Japan. However, according to the National Accounts of Japan, since the mid-1970s, Japan's national saving rate has been decreasing drastically and this trend seems to be continuing. In 2006, the aggregated saving rate dropped to 3.3 percent. In recent years, enterprise saving has been increasing and instead of households and the government, they have provided capital for investment (Figure 2.2). Capital also can be obtained from abroad and the actors who would like to invest do not encounter serious liquidity constraints in Japan. However, depending too much on foreign countries for capital causes vulnerability. Thus, it is important to analyze how household saving rate pattern has been changing.

Of the many papers which deal with the recent Japanese saving rate, some showed that the combined effects of demographics and slower total

factor productivity growth explained the decline in the saving rate (Braun, Ikeda, Joines, 2004). In addition to these factors, Chen, Imrohoroˇglu, and ˙Imrohoroˇglu (2007) indicated that fiscal policy also influenced the saving rate. One paper emphasized that diversity in saving behavior was important in determining household saving in Japan (Campbell, 2004). Horioka (1997) mentioned that the age structure of the population had an impact on Japan's saving rate and the life cycle model could be applied to Japan. Koga (2006) also found that demographic factors were a major cause of the sharp decline in the Japanese saving rate in the 1990s.

Referring to Horioka's paper, several claims need to be checked. One is whether or not the life cycle model can explain the trend of the aggregate household saving in Japan. According to Horioka (1997), one of the most powerful tests of the life cycle model is to test whether the age structure of the population has the hypothesized effects on the saving rate. This paper will provide an analysis of how the age structure of the population influences the household saving rate in Japan by applying cointegration techniques to time series data for 1955-2006. The results will show whether the life cycle model can still be applied to Japan and whether the changes in Japan's saving rate were the result of the changes in the age structure of its population (Figure 2.3 and 2.4).

Investigation into the aggregated household savings is not enough to realize the changes in saving rate. A household survey also needs to be examined to understand the factors which bring about the decrease in saving patterns. For the most part, past papers did not use household-level panel data but used repeated cross section data. Thus, in this paper, the household-level panel data will be used to investigate the characteristics of the household

saving behavior and whether the life cycle model can be applied to the individual household saving behavior. By using the micro panel data, the changes in saving rates with age, year of birth of the head of household, and time will be investigated, applying a variant of the decomposition in Deaton and Paxson (1994). In their paper, they examined issues of life-cycle saving, growth, and aging in Taiwan with the repeated cross section household data from 1976 through 1990.

One of the interesting expected results from this decomposition will be people's saving pattern over their lifetime. Another interesting result from the decomposition will indicate whether there remains a substantial time trend in household saving rates. Education, welfare service and housing might be related to saving behavior. Recently the fertility rate in Japan has been falling and the number of children per household has been decreasing. It is likely that parents do not need to save money for their children's education. For an aging society like Japan, welfare benefits such as health care and pensions, have been enhanced and the risk for the future seems to be reduced. However, people are doubtful about whether the existing system will be sustainable in the future. Thus, the welfare services may have an ambiguous effect on household saving.

The remainder of the paper is organized as follows. Section 2 provides a macro data investigation with time series analysis, section 3 deals with the panel data, and section 4 reviews the results and suggests some policy implications.

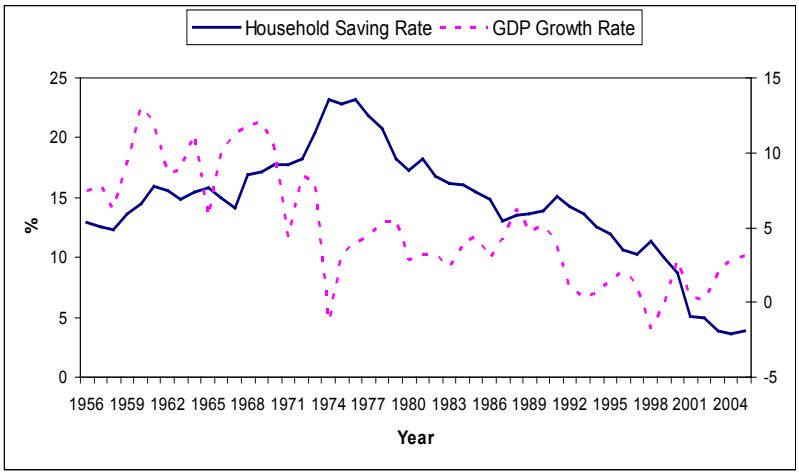


Figure 2.1 Aggregate Household Saving Rate and GDP Growth Rate

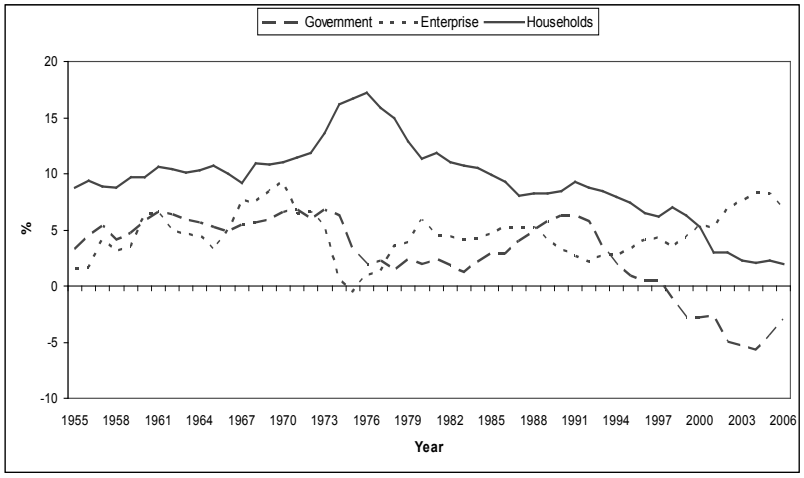


Figure 2.2 Contribution to Gross Domestic Savings as a percentage of GDP

2. Macro Data Analysis

2.1 Model

According to the life cycle model, people work and save income when they are young. Then, when they retire, they do not continue saving. Thus, when the ratio of the aged population to the productive-age population is high, the aggregate saving rate will be low. Similarly, those who have not started

working yet, i.e. children, consume but do not obtain income, and accordingly the ratio of the child population to the productive-age population will also have a negative impact on the aggregate saving rate. With the assumption that (i) people start working when they are S years old, work for P years, retire at age R, and die at age D, (ii) consumption and income are independent of age, (iii) there is no productivity growth, (iv) there are no bequests or other intergenerational transfers, and that the interest rate is zero, it can be shown, using Horioka's (1997) model, that the aggregate saving rate SR will be as follows:

$$SR = \frac{S+R}{D} - \frac{P}{D} \cdot CHI - \frac{P}{D} \cdot AGE, \qquad (1)$$

where CHI = ratio of child population to productive-age population, AGE = ratio of aged population to productive-age population.

In other words, the aggregate saving rate will decrease with respect to both CHI and AGE, and the coefficients of these variables will be negative. In addition, the result that SR decreases with respect to CHI and AGE does not change even when the assumptions mentioned above are excluded. Thus, in the empirical analysis, SR is specified as a function of CHI and AGE except that, as an approximation, CHI is defined as the ratio of child population to productive-age population and AGE as the ratio of aged population to productive-age population.

2.2 Data

The dependent variable is the net saving rate of the household sector, which is defined as the ratio of net household savings to net household disposable income. The data necessary for the computation of this variable were obtained from the National Accounts (NA) of Japan, which the Cabinet Office of the Government of Japan compiles based on the System of the National Accounts (SNA) recommended by the United Nations. Net household saving and net household disposable income are based on historical cost depreciation and are exclusive of capital transfers in NA. According to Horioka (1995), theoretically, the data based on replacement cost depreciation and inclusive of capital transfers are preferred. Horioka defined the household sector broadly, which included private unincorporated nonfinancial enterprises and private nonprofit institutions. However, in this paper, the household sector is defined more narrowly. In fact, the correlation between the data from NA and that revised by Horioka is very high (0.9837). This paper will use the household data from NA directly.

Population data were obtained from the Report on Population Estimates by the Ministry of Internal Affairs and Communication of the Government of Japan. Census data were used for years ending in 0 or 5, and official estimates were used for all other years. Data on SR, CHI and AGE for the 1955-2006 period are shown in the appendix with their means and standard deviations. Trends over time in SR, CHI and AGE can be seen from figure 2.A respectively. As figure 2.A.1 shows, SR indicates a humped pattern, increasing until the mid-1970s and then declining. Regarding the demographic variables, CHI declined sharply until the early 1970s and then more moderately, while AGE increased moderately until the early 1970s and then

more sharply. Thus, assuming that both CHI and AGE had a negative impact on SR, they appeared capable of explaining the trends over time in SR. The sharp decline in CHI until the early 1970s explains the upward trend in SR during this period, and the sharp increase in AGE since the mid-1970s explained the downward trend in SR during this period.

2.3 Time Series Analysis

2.3.1 Time Series Properties of the Data

First, the time series properties of the data were examined with augmented Dickey-Fuller (ADF) tests. The results are given in table 2.1, and as this table shows, the saving rate variables had a unit root in their levels and were stationary in their first differences, so they were $I(1)$. Although CHI and AGE were found to be $I(2)$, because the null hypothesis of a unit root in their first differences was accepted by a relatively small margin, all variables could be assumed to be $I(1)$.

2.3.2 Tests of Cointegration

Next, based on the results of ADF tests, a cointegrating relationship among the three variables SR, CHI, and AGE was tested with Johansen methods. The results are given in table 2.2. As this table shows, the Johansen method found that the hypothesis of no cointegrating relationship was strongly rejected. It could be concluded that there was a cointegrating relationship among SR, CHI, and AGE.

With respect to the number of cointegrating equations, the Johansen method found that the null hypothesis of at most one cointegration equation was rejected, whereas the null hypothesis of at most two cointegration

equations was not rejected. In light of these results, it was assumed that there were two cointegrating equations.

2.3.3 Estimate of the Cointegrating Vectors

Then, the cointegrating vectors, which described the long-run relationship among the variables, were discussed. Johansen maximum likelihood estimates of the cointegrating vectors are given in table 2.3. As this table shows, AGE had a negative impact on SR, as predicted by the life cycle model. Moreover, the coefficient of the variable, AGE, varies relatively little, with the coefficient ranging from 2.23 to 3.87. However, the coefficient of CHI was equal to zero, which was not consistent with the life cycle theory. The simplified life cycle model presented in this section predicts that coefficients of the two variables will be equal to one another and less than 1 in absolute value, but the coefficient of AGE was larger than the coefficient of CHI, and it was also larger than 1. Moreover, this finding that the coefficient of AGE was larger than the coefficient of CHI could be explained by the fact that the per capita consumption of minors was likely to be less than per capita consumption of the aged. Finally, note that the coefficients of CHI and AGE were statistically significant.

2.3.4 Estimates of the Error-Correction Model

Given the finding that SR, CHI, and AGE were cointegrated, an error-correction model (ECM) was estimated to determine the short-run dynamics of the system. The results are given in table 2.4, and as this table shows, the coefficient of the error-correction term was negative and statistically significant in the saving rate equation, meaning not only that the ECM was valid but also

that there was a significant conservative force tending to bring the model back into equilibrium whenever it strayed too far. Moreover, the results of the diagnostic tests indicate that the saving rate equation passed the tests for serial correlation, functional form, and heteroskedasticity, but violated the normality. The other equations failed the tests for serial correlation, functional form, and normality in some cases. However, the violation was not so significant and the saving rate was mainly focused, so no additional adjustment was conducted here.

2.3.5 Estimates of Impulse Response Functions

In this subsection, estimates of impulse response functions based on the ECM of the previous subsection will be presented. These impulse response functions show the impact of changes in the age structure of the population on the household saving rate. Selected results are given in 2.5 and figure 2.3. As this table shows, a 1 percentage point increase in CHI and AGE seemed to have a permanent impact on SR. First, the shock of CHI had a negative impact on SR and then, it had positive impacts on SR, turning back to negative. This could be explained by the fact that if people have more children, they start to save money for their education, which results in the increase in saving rate. However, the education fees will exceed their saving after a while. On the other hand, people of retirement age and above continue to consume with less income and this has a negative impact on the saving rate permanently.

2.3.6 Results

In this section, it was found, by applying cointegration techniques to time series data on Japan for the 1955-2006 period, that the age structure of the population affected household saving in Japan to some degree. It has been said that the life cycle model was less likely to apply to Japan due to cultural peculiarities, such as the greater prevalence of intergenerational transfers (Hayashi, 1986). This still seemed to be true.

It was found that the ratio of the aged to the working age population had a negative and significant impact on the household saving rate. This finding constitutes strong evidence in favor of the life-cycle model. However, the impact of the ratio of the minor to the working age population on saving rate seemed ambiguous. It will have a both negative and positive impact on the saving rate. It is not consistent with other types of evidence concerning the applicability of the life-cycle model to Japan. The findings suggest that Japan's high household saving rate might have been due in part to the young age structure of the population and that the household saving rate might decline as the population ages.

As a whole, only the age structure of the population did not seem to explain the change in the household saving rate in Japan. In fact, based on the SNA, although the worker's household saving rate stayed at the same level (Figure 2.7), the non occupation household saving rate has dropped sharply (Figure 2.8), which indicates that people's saving behavior might have changed recently. Therefore, it is necessary to investigate the household level saving behavior to understand what has happened to the household saving.

Table 2.1 Results of ADF Test

Variable	Type of Test	Without Trend	5% Critical Value	With Trend	5% Critical Value
SR	ADF(0)	0.549	-2.929	-1.164	-3.499
	ADF(1)	0.082	-2.930	-1.216	-3.500
	ADF(2)	-0.200	-2.933	-1.462	-3.504
D_SR	ADF(0)	-5.434	-2.930	-6.035	-3.500
	ADF(1)	-3.755	-2.933	-4.444	-3.504
	ADF(2)	-3.213	-2.936	-4.129	-3.508
D2_SR	ADF(0)	-10.951	-2.933	-10.827	-3.504
	ADF(1)	-7.206	-2.936	-7.121	-3.508
	ADF(2)	-5.917	-2.938	-5.855	-3.512
CHI	ADF(0)	-5.934	-2.929	-3.118	-3.499
	ADF(1)	-1.769	-2.930	-2.249	-3.500
	ADF(2)	-2.057	-2.933	-2.155	-3.504
D_CHI	ADF(0)	-2.339	-2.930	-2.620	-3.500
	ADF(1)	-2.654	-2.933	-3.087	-3.504
	ADF(2)	-2.125	-2.936	-2.545	-3.508
D2_CHI	ADF(0)	-6.171	-2.933	-6.115	-3.504
	ADF(1)	-5.578	-2.936	-5.512	-3.508
	ADF(2)	-5.242	-2.938	-5.158	-3.512
AGE	ADF(0)	21.363	-2.929	4.572	-3.499
	ADF(1)	4.600	-2.930	3.007	-3.500
	ADF(2)	4.046	-2.933	3.147	-3.504
D_AGE	ADF(0)	-0.539	-2.930	-3.783	-3.500
	ADF(1)	0.071	-2.933	-2.912	-3.504
	ADF(2)	0.326	-2.936	-2.433	-3.508
D2_AGE	ADF(0)	-9.218	-2.933	-9.242	-3.504
	ADF(1)	-6.182	-2.936	-6.214	-3.508
	ADF(2)	-5.684	-2.938	-5.765	-3.512

Table 2.2 Johansen Test for Cointegration

Maximum Rank	Trace Statistics	Critical Value
0	57.95	29.68
1	18.96	15.41
2	2.87	3.76

Table 2.3 Estimates of the Cointegrating Vectors

Cointegration Equation 1	Coefficient	SE
SR	1	----------
CHI	5.55E-17	----------
AGE	3.032	0.411
Constant	-49.954	----------
Cointegration Equation 2	Coefficient	SE
SR	Dropped	----------
CHI	1	----------
AGE	-7.342	1.935
Constant	4.991	----------

Table 2.4 Estimates for ECM

	D_SR	D_CHI	D_AGE
Z1(-1)	-0.474	0.122	0.017
	-3.94	2.77	1.34
Z2(-1)	-0.121	0.020	-0.001
	-4.02	1.77	-0.23
D_SR(-1)	0.350	-0.096	-0.009
	2.47	-1.84	-0.63
D_SR(-2)	0.215	-0.038	0.010
	1.49	-0.71	0.68
D_CHI(-1)	-0.146	0.818	0.051
	-0.36	5.44	1.20
D_CHI(-2)	0.912	-0.262	-0.059
	2.30	-1.80	-1.42
D_AGE(-1)	-0.221	-1.319	0.155
	-0.14	-2.35	0.97
D_AGE(-2)	0.496	-1.053	-0.108
	0.29	-1.69	-0.61
Constant	-0.009	-0.050	0.116
	-0.02	-0.27	2.21

Table 2.5 Impulse Response Functions

	CHI	AGE
1	-0.091	-0.079
2	0.098	-0.061
3	0.244	-0.129
4	0.240	-0.264
5	0.078	-0.332
6	-0.107	-0.276
7	-0.221	-0.151
8	-0.251	-0.048
9	-0.240	-0.008
10	-0.226	-0.016
15	-0.252	-0.069

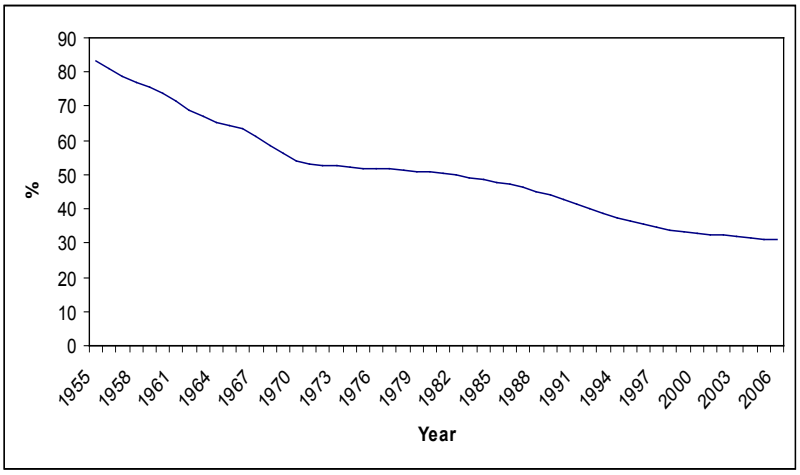


Figure 2.3 Ratio of Child Population to Productive-Age Population

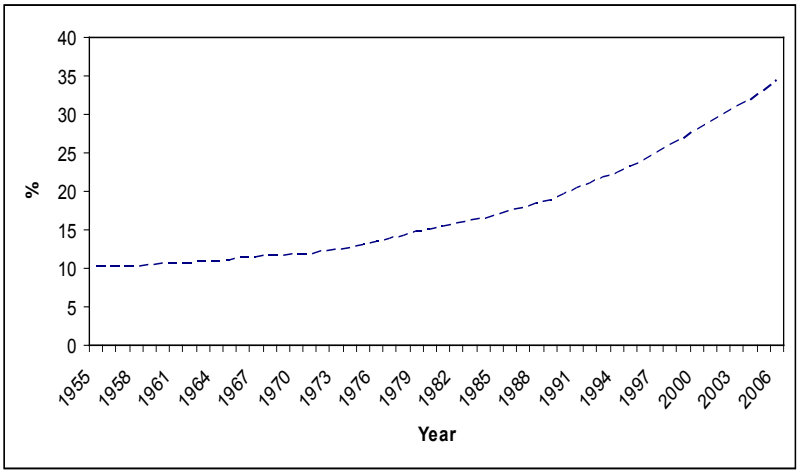


Figure 2.4 Ratio of Aged Population to Productive-Age Population

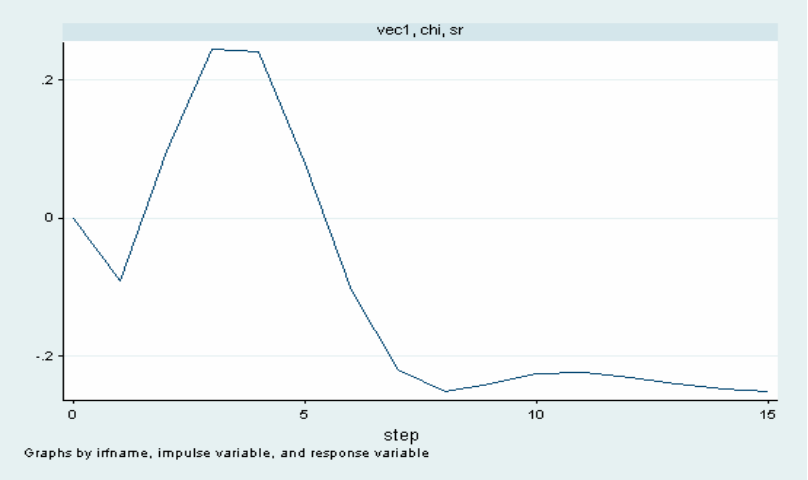


Figure 2.5 Impulse response function of child population on saving rate

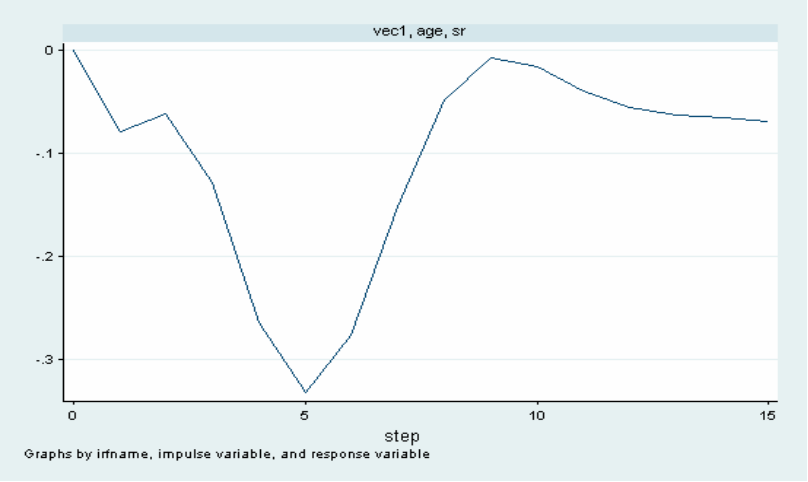


Figure 2.6 Impulse response function of aged population on saving rate

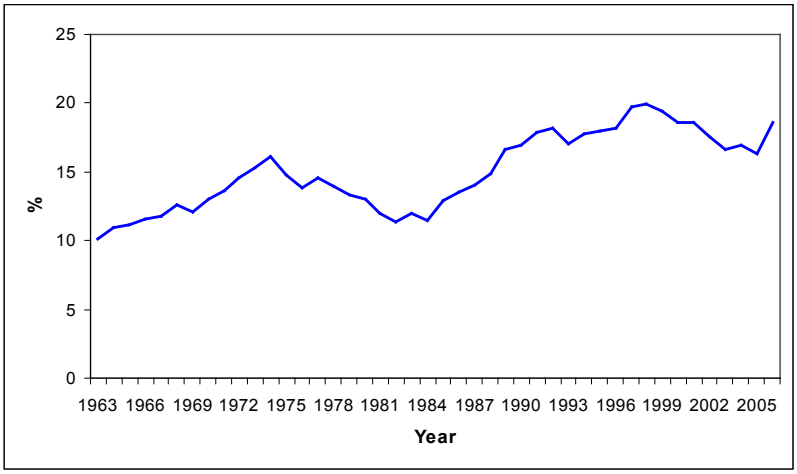


Figure 2.7 Worker's Household Saving Rate

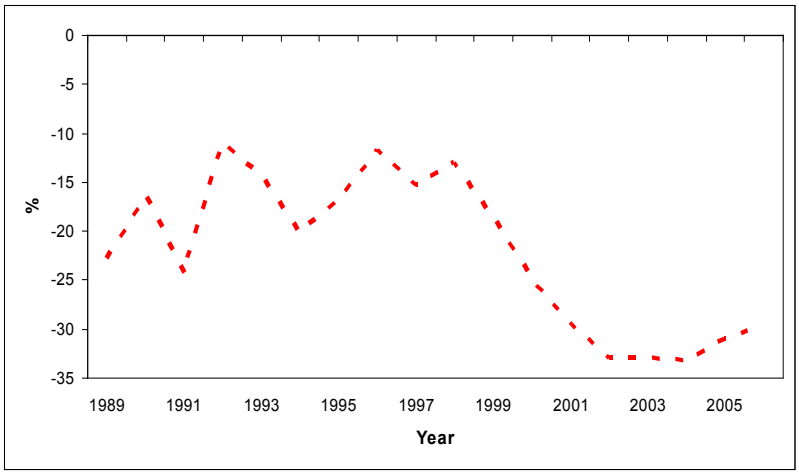


Figure 2.8 Non Occupation Household Saving Rate

3. Decomposition Analysis

This paper estimates how saving rates vary according to time, age, and cohort of the household head, using a variant of decomposition in Deaton and Paxson (1994). This study found the traditional “hump-shaped” profile of savings over the life cycle of an individual where saving rates were at their low when people were young but achieved their peak when the earning potential was the highest and then fell off as workers approached retirement. This relationship between age and saving rates differs from what previous studies had said about household saving in Japan. Demographic shifts did not go far enough to explain saving behavior. Even after broader demographic shifts were under control, there remained a substantial trend over time in household saving rates, implying that the falling saving rates must be the result of economy-wide changes affecting all households. As with most other studies using household data, very limited consumption smoothing over the life cycle was found.

The overall macroeconomic uncertainty associated with the recession in the 1990s should have contributed to precautionary saving motives. However, strong evidence was not found that the effects of macro uncertainty were quantitatively important.

The target saving hypothesis is also investigated, according to which households have a target level of saving. Since bank deposits are the primary financial assets for Japanese households, their saving rates should be then negatively correlated with real returns on bank deposits if this theory is correct.

After examining the empirical relevance of various hypotheses individually in the next section, in section 5, it was estimated that a composite regression to evaluate the relative importance of the most promising ones was necessary. It was found that savings were also higher for households whose composition portends large education expenditure in the future. These and other strands of evidence suggest that precautionary motives and the rising burden of social expenditure drove the increase in household saving rates. In the composition regression, the effects of home ownership status on savings were somewhat negative on average, although it was not found that owners of poor-quality homes had higher saving rates than those with better homes. It was also found that owing a home was associated with lower saving rates among young households. All of these effects were amplified in an environment of financial restrictions, which resulted in the lack of instruments for borrowing against any future income, limited opportunities for portfolio diversification, and low real returns on bank deposits.

3.1 Data

The Institution for Research on Household Economics designed, implemented and analyzed the Japanese Panel Survey of Consumers (JPSC) with a focus on changing lifestyles. This employed the panel research method to track the same individuals over multiple periods of time. Cohort A consisted of a group of young women aged between 24 and 34 who were randomly selected from across Japan in 1993 for an in-home questionnaire survey. Cohort B, consisting of women aged between 24 and 27 in 1997, and cohort C, consisting of women aged between 24 and 29 in 2003, were added respectively in 1997 and 2003. The relatively high response rate of this annual survey overcame the inherent disadvantages of a panel survey. They designed, implemented and analyzed this research project with a focus on changing lifestyles. Many of the people selected as participants in the study were at an age where their previously similar lifestyle paths begin to branch out and diversify. The objective of this study was to identify various factors and problems associated with the changes and differences in the lifestyles of the study participants.

The measure of disposable income included labor income, property income, transfers, and income from household sideline production. The consumption expenditure variable covered a broad range of categories. It also provided demographic and employment information about household members, living conditions, and a number of other household characteristics. Table 2.6 reports summary statistics for household income, consumption, loan, and the resulting saving rates. The table describes the changes in the distribution of consumption across different groups of goods. Neither income nor consumption measures captured the consumption value of owner-

occupied housing. All flow variables were expressed on an annual basis and, nominal variables were adjusted using the CPI.

A potential concern at this juncture was that the micro data indicated household saving rates different from those suggested by the aggregate data taken from the National Survey of Accounts. The discrepancies between micro and macro data on saving ratios are an issue in almost every country where both types of data are available. Perhaps more importantly, it is usually difficult to get adequate survey response rates from high-income households. These households tend to have high saving propensities. The shares of total saving accounted for by each income decile showed that the top decile accounts for over one-fourth of total savings. The increase in saving rates was also more pronounced among the richer households. Thus, an under-sampling of rich households could understate average savings.

Figure 2.9 compares the average worker's household saving rate from a family income and expenditure survey compiled by the Ministry of Internal Affairs and Communications of the Government of Japan and the mean household saving rate from JPSC data. It indicates that both data had similar tendencies and the JPSC data was reliable. The relationship between saving rate and the age of household heads is shown in figure 2.17. According to this figure, the household saving rate increased from their early 20's and reached its peak during their 40's. Then it started to go down. The data seem to be consistent with the life-cycle theory and this will be checked a later section.

3.2 Stylized fact

A basic empirical characterization of saving patterns based on the micro data is mentioned. Figure 2.11- 2.14 shows, for selected years from

1993 to 2005, averages of disposable income and consumption as a function of the age of the household head. There was little change in average income over this period, with consumption following income. The age profiles of income (Figure 2.11-2.14) exhibit a familiar hump-shaped pattern in all selected periods. That is, income initially increased with age but, after peaking several years before their retirement, began to decline. Interestingly, the peak was getting later and moved from the late 40s in 1993 to the early-50s in 2005. This might be related to the fact that their retirement age was becoming older. This phenomenon of rising retirement age is typical for an aging society. Figure 2.23 plots income and consumption against the age of the household head, with each line corresponding to a different cohort. This figure shows that consumption tracked income over the life cycle across cohorts, confirming the lack of consumption smoothing over the life cycle. Controlling the demographic characteristics of households does not alter the consumption profiles, which still increased substantially over time. Figure 2.24 plots the saving rate as a function of the age of the head of household in the panel data of households for 1993, 1997, and 2003. In 1993, the age-saving profile exhibits a hump-shaped pattern, with the saving rate increasing with age, peaking at around age 40, and then declining with age. Such behavior is close to what life-cycle theory would predict, given borrowing constraints that limit borrowing against future income and rising labor earnings over certain ranges of the working life. This pattern did not change over all periods, and the slope of decline curb was even steeper than income, meaning that household consumption did not decrease as much as income.

The cohort, age and time effects and their roles in saving behavior was separately discussed. In this section, econometric approach is used to disentangle these effects.

3.3 Model

As mentioned above, Japan is undergoing a major demographic transition. The low fertility rate and the increase in the number of elderly have increased the old-age dependency ratio and are projected to increase it further in coming years. Hence, a more careful analysis of demographic factors seems warranted in accounting for the decline in the savings ratio.

The age and cohort profiles of household savings represent a composite of age, cohort, and time effects. Different age and cohort groups are likely to have had different saving behavior and these are likely to change over time. It is therefore necessary to separate out age, cohort and time effects in order to more clearly characterize the effects of demographic variation on changes in saving patterns. The contribution of these effects to savings is decomposed by adapting the approach of Deaton and Paxson (1994).

If there is no income uncertainty, the life-cycle model indicates that consumption is a function of wealth, earnings plus inherited assets, as dictated by preferences and the life-cycle variation in household size and composition. Based on Deaton's model,

$$c = g(a)W \,, \tag{2}$$

where W is the sum of assets and the discounted present value of current and expected future income, and $g(a)$ is a function of age a. Appling logarithm gives,

$$\ln c = \ln g(a) + \ln W \,. \tag{3}$$

The extension (3) is to allow for fixed year effects, so the consumption equation becomes

$$\ln c_{at} = \ln g(a) + \ln W_b + \theta_t \,, \tag{4}$$

where θ_t is a year-long fixed effect, and the subscripts a, b, and t denote age, cohort, and time, respectively.

The estimation (4) requires care regarding the relationship between age, cohort, and year dummies. Using C, Y and A, for the matrices of the dummy variables of cohort, year and age dummies. Equation (4) can be rewritten in terms of the dummy variable matrices as

$$\ln c_{at} = \iota\beta_c + C\gamma_c + A\alpha_c + Y\psi_c + \varepsilon_c \,, \tag{5}$$

where ι is a vector of units, and the vectors α_c, γ_c, and ψ_c are parameters of age, cohort, and year effects.

Since age minus cohort equals year plus a constant, in the absence of constraints on these dummies any trend could be the result of different combinations of year, age, and cohort effects. Deaton and Paxson (1994)

identify age and cohort effects by imposing the constraint that the year effects must add up to zero and be orthogonal to a time trend.

$$\sum_t \psi_c = 0 \text{ and } \sum_t \psi_c t = 0$$

This constraint forces the decomposition to attribute the rising income and consumption over time to age and cohort effects, overwhelming most of the other variation in consumption and saving behavior.

If the age profile of income is invariant to economic growth, then income can also be expressed as a function of age and lifetime resources. An equation for disposable income that is analogous to the one for consumption is estimated as follows:

$$\ln y_{at} = \iota\beta_y + C\gamma_y + A\alpha_y + Y\psi_y + \varepsilon_y, \quad (6)$$

where ι is a vector of units, and the vectors α_y, γ_y, and ψ_y are parameters of age, cohort, and year effects. Once the effects of a variable on consumption and income are estimated, then its resulting effect on the household saving rate can be obtained. When these equations are estimated, the following demographic controls are included: log family size and the proportion of individuals in the household aged: 0-4, 5-9, 10-14, 15-19, 20-59 and 60 or above.

3.4 Age, Cohort and Time Effects in Household Saving Rates

In order to check how the life cycle mode fits the case in Japan, equation (5) is estimated with 47 age dummy variables, 13 year dummy variables and 5 cohort dummy variables based on the following categorization.

Figure 2.25-2.27 show the estimated age and cohort profiles of income, consumption and saving rates. The profile for one type of effect assumes that the others are kept constant. The baseline household is one whose head was 25 years old in 1993. For example, the age profile shows how income and consumption would vary with age holding the cohort effect constant at the level for the cohort 1 and the year effect at its 1993 level. Similarly, the cohort profile shows how income and consumption would vary with year of birth holding the age effect constant at its level for 25 year olds and the year effect at its 1993 level. Finally, the year profile indicates the variation over time holding the age effect constant at its level for 25 year olds and the cohort effect at the level of those born in 1965.

The results reveal that consumption tended to track income. The age effects show that income and consumption increased until the age of early 50s, and then declined. The implied effect on the saving rate, approximated as log (Y) – log (C), was similar to the saving rate profile as a function of age observed in the panel until the age of early 50s. It indicates that households saved more as they got older, but then the saving rates gradually declined. This hump-shaped pattern of savings is typical but is different from what the previous studies suggest. It is also consistent with the life cycle/permanent income hypothesis.

The cohort profiles of income, consumption suggested that younger cohorts had relatively higher incomes than those cohorts who were in their late

30s and early 40s in 1993. The resulting effect on savings suggested that the higher saving cohorts were those that were in their 30s in 1993. This may be capturing the fact that those younger cohorts might have born the brunt of the increase in uncertainty associated with the shrinking in pension funds under the aging society after high economic growth. The sharp increase in the saving rate in the later working years was also consistent with postponing retirement savings until retirement was near. It is worth noting that cohorts that were in their forties in 1993, arguably the ones most affected by the high economic growth in the early 1970s, were not high saving cohorts. Finally, the time profile is analyzed. The time effects pointed to both upward and downward trends in income and consumption. The time effects on saving rates reached their peak in 1997, which saw the financial crisis in Asia, and 2001, which saw the collapse of the IT bubble. This suggests large negative impacts encouraged people to reduce their consumption and expand their saving.

Table 2.6 Summary Statistics

Year	Observations	Income (1993 1000yen)	Consumption (1993 1000yen)	Loan (1993 1000yen)	Household size	Saving Rate
1993	1,013	288	192	33	4.17	0.21
1994	1,039	306	198	38	4.24	0.22
1995	1,035	321	204	44	4.27	0.22
1996	1,041	324	205	46	4.27	0.22
1997	1,290	309	196	44	4.12	0.21
1998	1,274	326	210	45	4.14	0.20
1999	1,238	330	215	47	4.17	0.19
2000	1,222	338	220	48	4.20	0.19
2001	1,065	347	222	53	4.15	0.19
2002	1,066	356	234	52	4.18	0.18
2003	1,439	333	224	48	3.87	0.17
2004	1,412	344	230	49	3.92	0.17
2005	1,381	350	239	48	3.93	0.17
Total	15,515	329	216	46	4.11	0.19

Table 2.7 Type of Employment for Household Heads (%)

Occupation	1993	1997	2003	2005
Agriculture	0.35	0.09	0.94	1.12
Fishery	0.35	0.18	0.29	0.37
Mining	0.69	0.36	0.07	0.15
Construction	13.31	13.54	14.35	14.21
Production	26.16	23.92	22.54	23.59
Sales	15.28	17.06	16.01	15.85
Finance	7.06	6.95	5.72	5.21
Transportation	8.91	8.12	8.77	8.48
Utility	2.31	2.08	1.81	1.56
Service	15.74	16.34	19.86	21.21
Public	9.72	11.28	9.28	8.18
Others	0.12	0.09	0.36	0.07

Table 2.8 Breakdown of Consumption Expenditure

Year	Food	Housing	Health	Education and Recreation	Transportation and Communication	Other
1998	26.3	19.2	3.3	15.5	6.6	29.1
1999	27.2	18.6	3.0	15.0	11.0	25.2
2000	26.9	18.9	2.6	15.2	11.0	25.4
2001	25.9	19.5	4.8	18.6	12.5	29.5
2002	26.1	19.1	2.6	17.2	12.6	27.5
2003	27.1	25.1	4.8	20.5	16.4	31.7
2004	24.6	20.0	3.8	18.0	13.8	29.6
2005	24.1	20.9	4.0	17.7	14.3	27.8

Table 2.9 Categorization of Cohorts

Cohort	Age in 1993
1	- 24
2	25 - 29
3	30 - 34
4	35 - 39
5	40 -

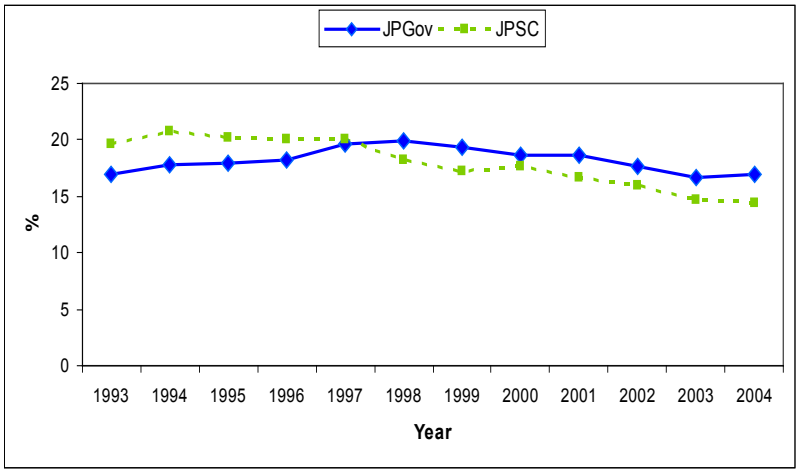
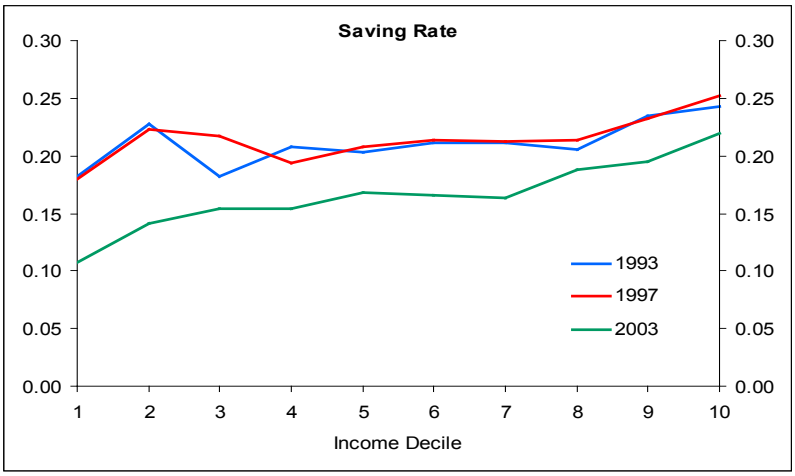


Figure 2.9 Comparison of two Household Surveys



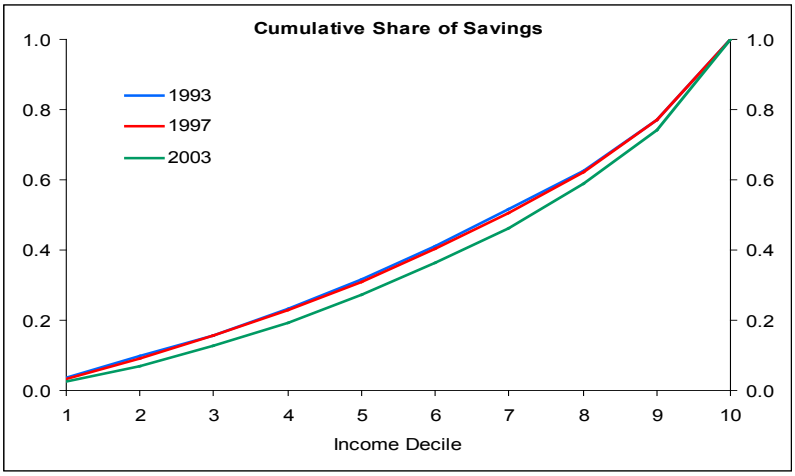


Figure 2.10 Saving Rate and Share of Total Savings by Income Quintile

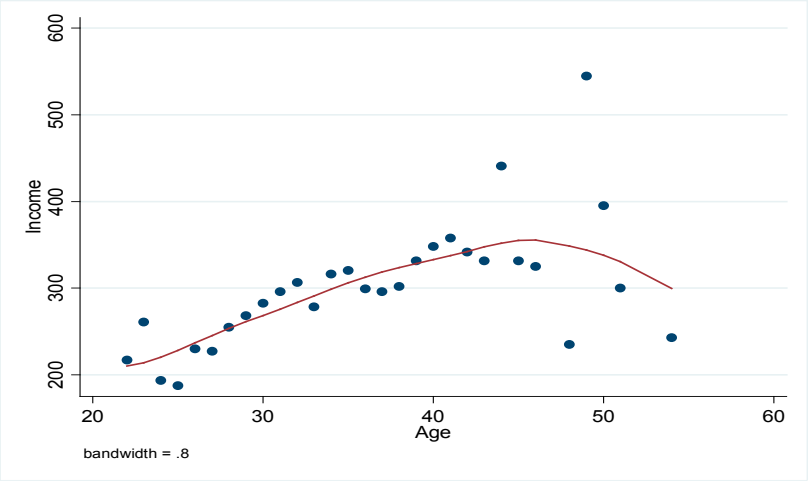


Figure 2.11 Household Head's Age and Income in 1993

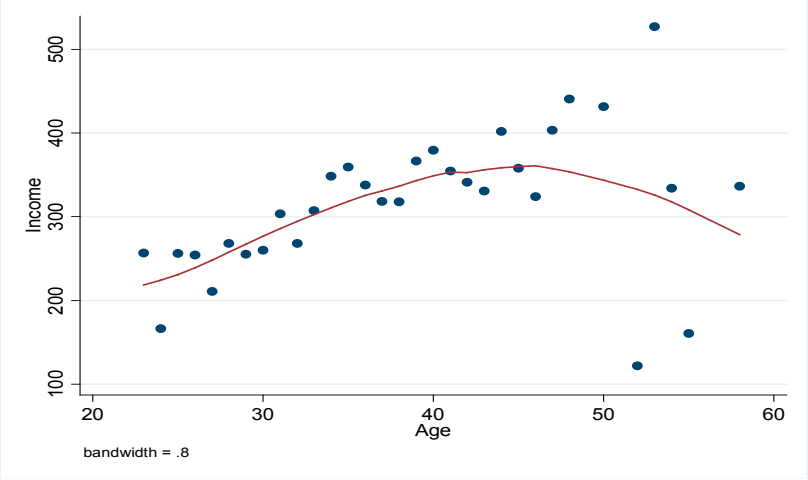


Figure 2.12 Household Head's Age and Income in 1997

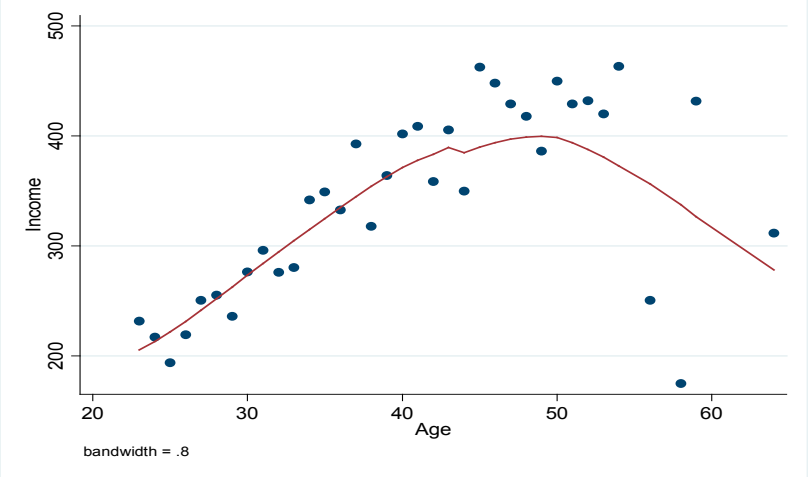


Figure 2.13 Household Head's Age and Income in 2003

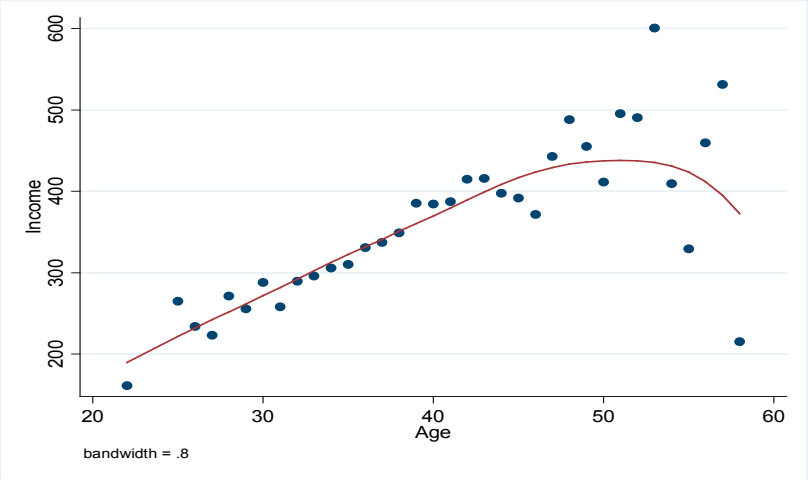


Figure 2.14 Household Head's Age and Income in 2005

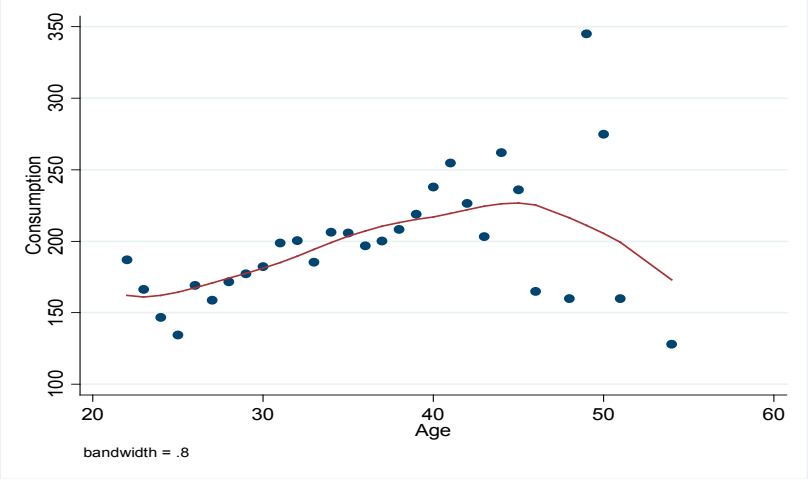


Figure 2.15 Household Head's Age and Consumption in 1993

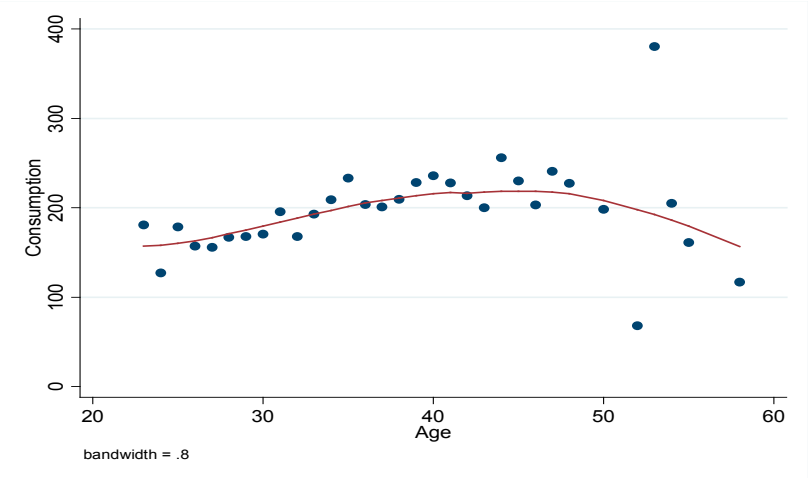


Figure 2.16 Household Head's Age and Consumption in 1997

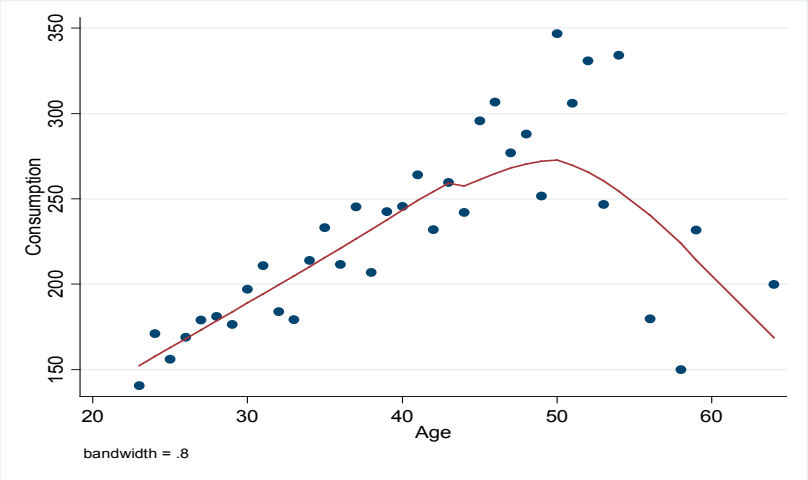


Figure 2.17 Household Head's Age and Consumption in 2003

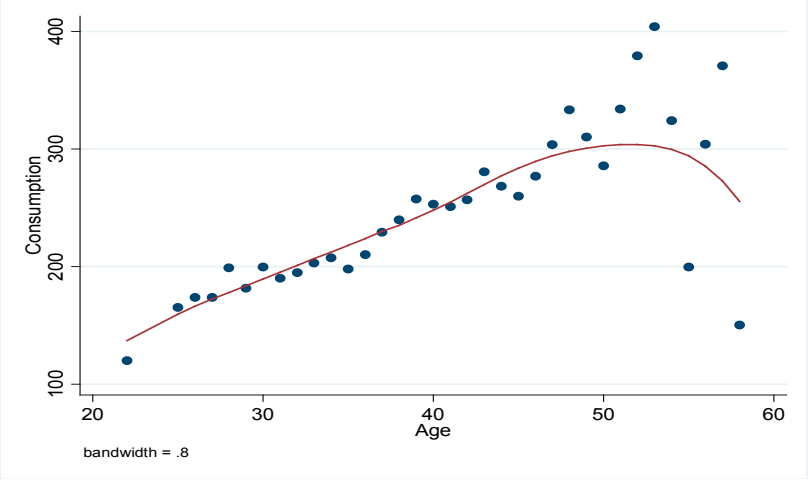


Figure 2.18 Household Head's Age and Consumption in 2005

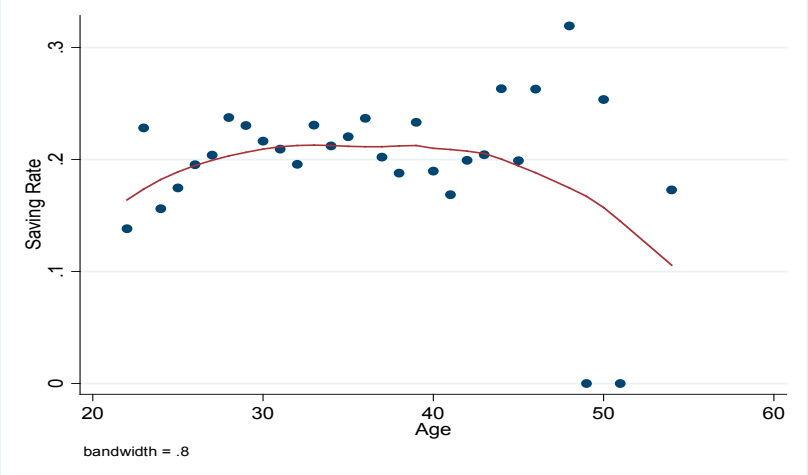


Figure 2.19 Household Head's Age and Saving Rate in 1993

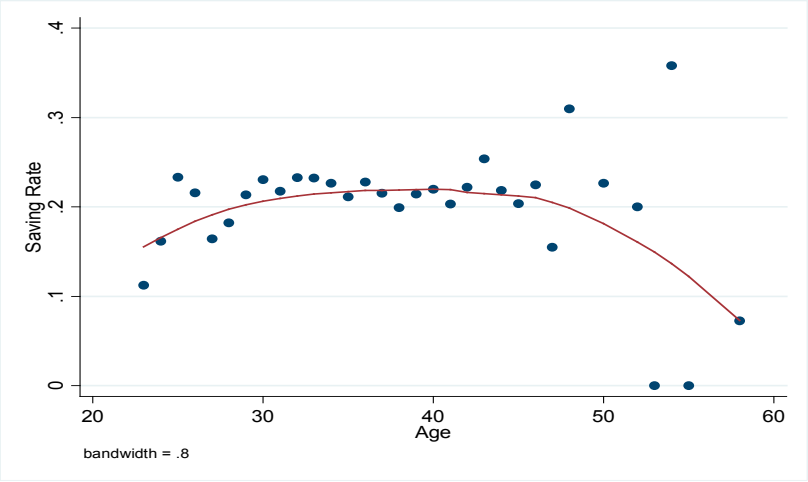


Figure 2.20 Household Head's Age and Saving Rate in 1997

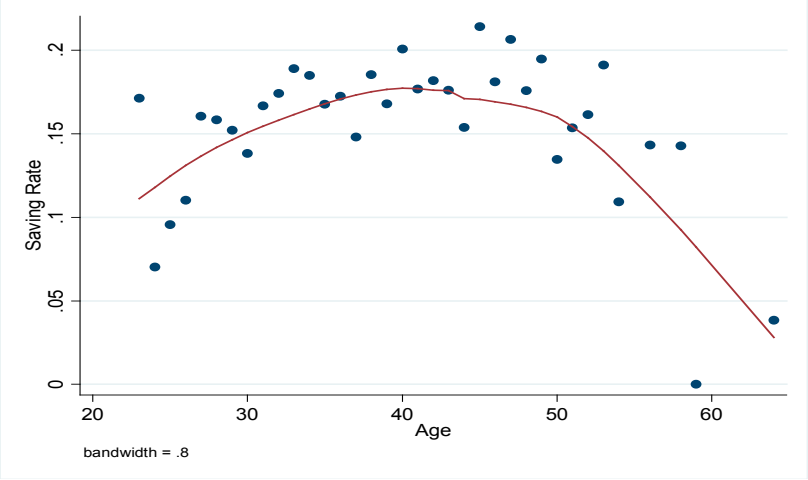


Figure 2.21 Household Head's Age and Saving Rate in 2003

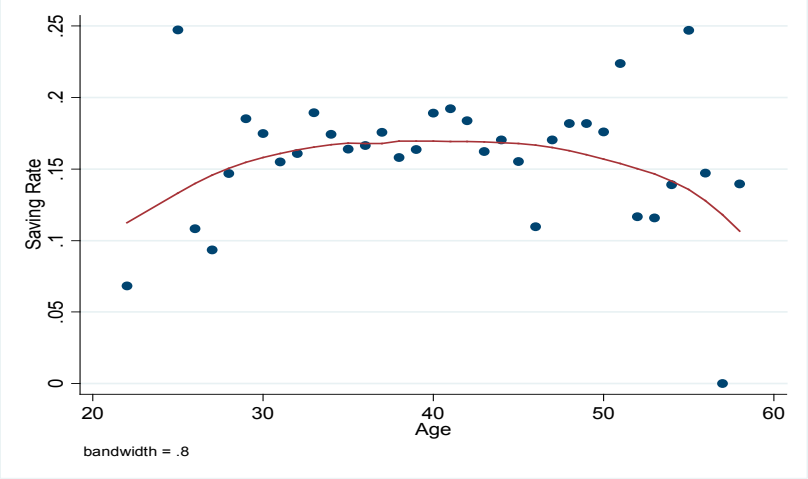
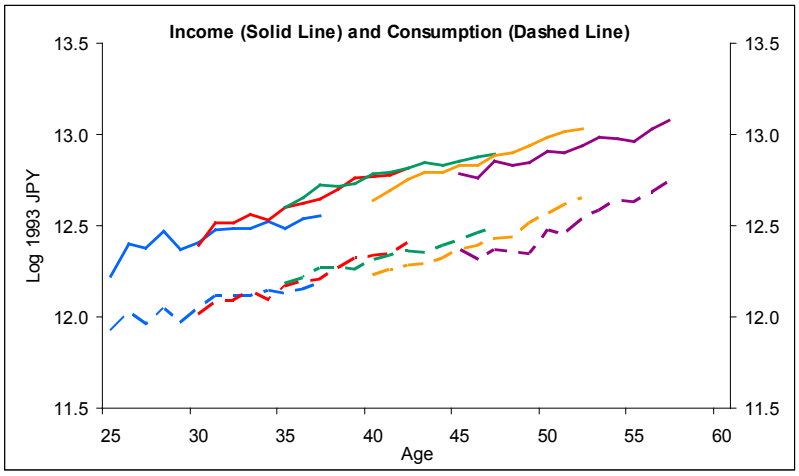


Figure 2.22 Household Head's Age and Saving Rate in 2005



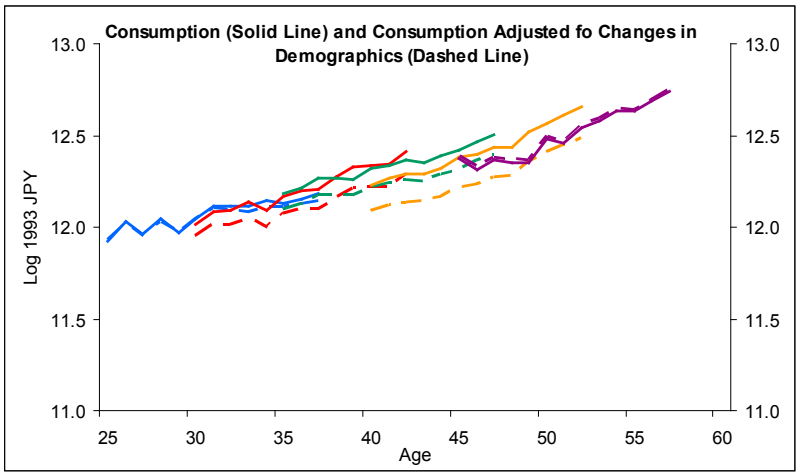


Figure 2.23 Income and Consumption for Different Cohorts Over Time

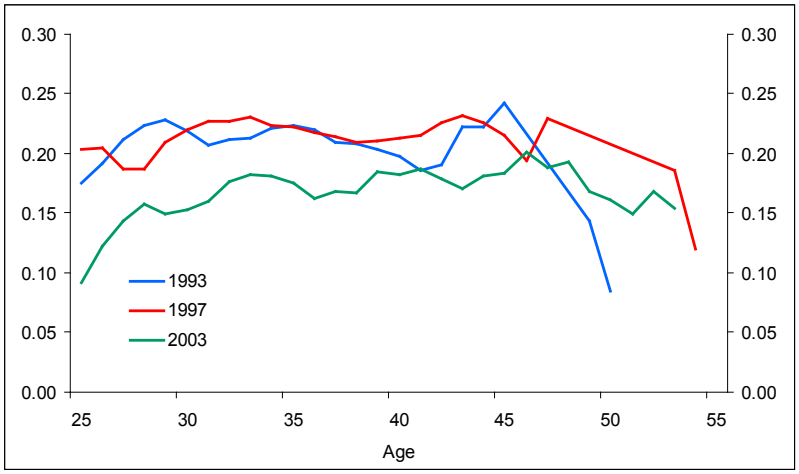


Figure 2.24 Average Saving Rates by Age of Head of Household

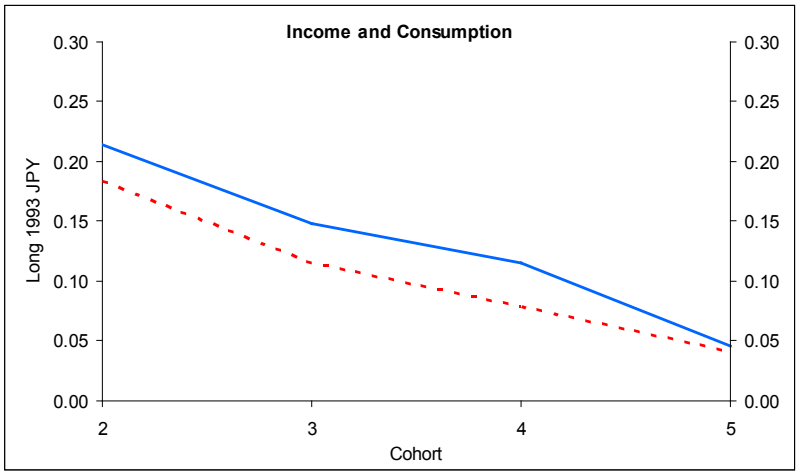


Figure 2.25 Cohort Effect on Income and Consumption

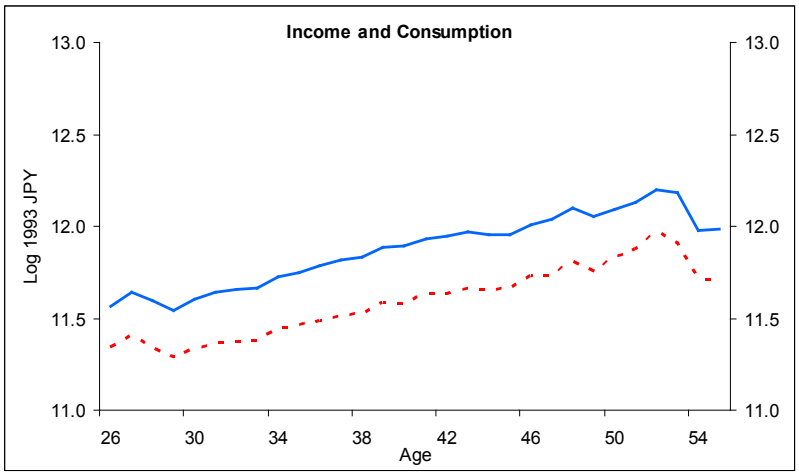


Figure 2.26 Age Effect on Income and Consumption

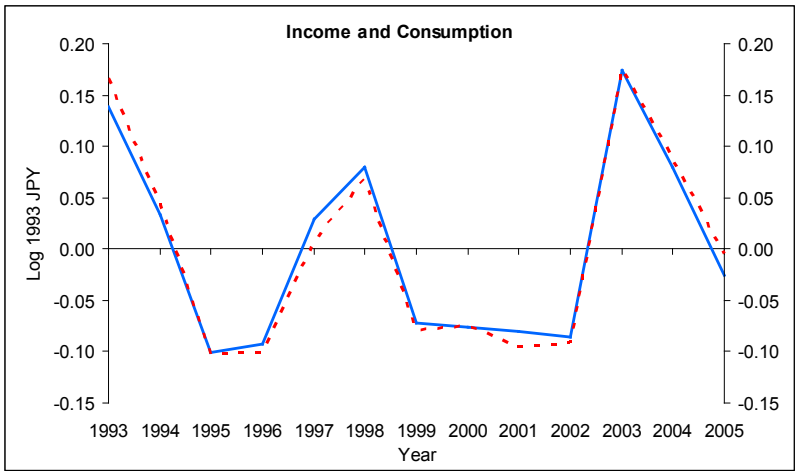


Figure 2.27 Year Effect on Income and Consumption

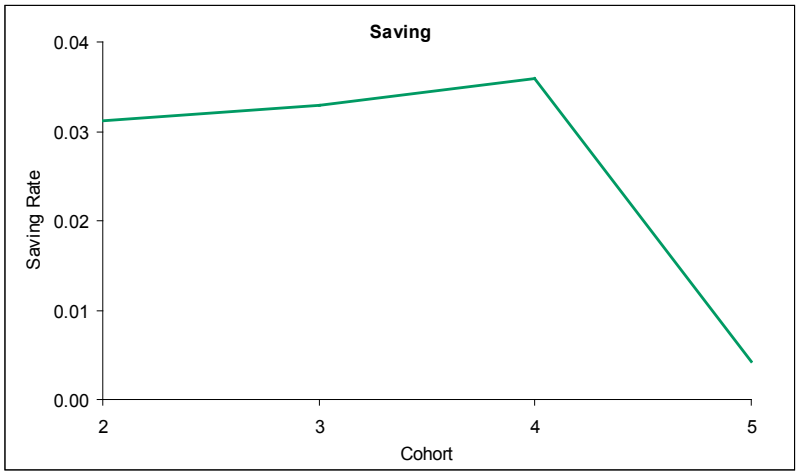


Figure 2.28 Cohort Effect on Saving

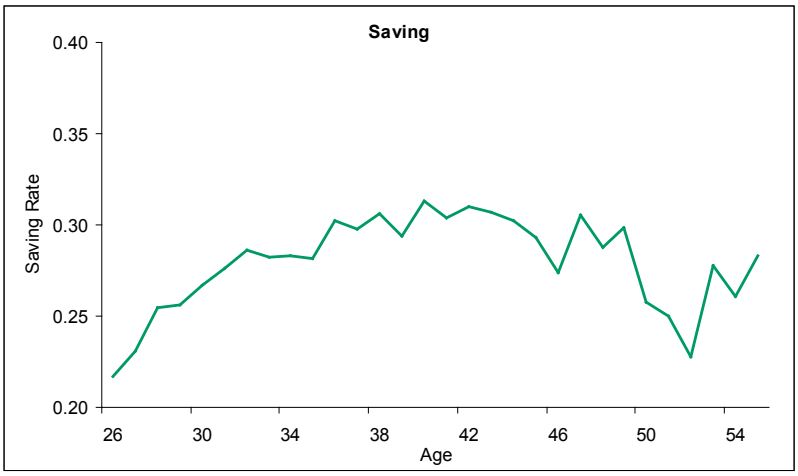


Figure 2.29 Age Effect on Saving

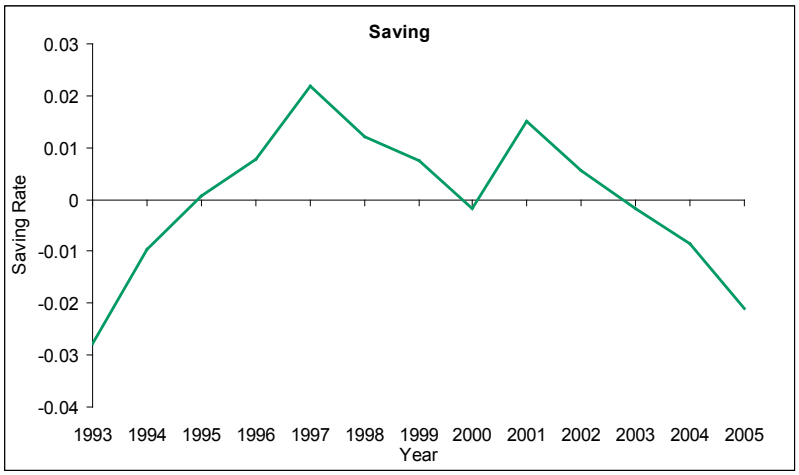


Figure 2.30 Year Effect on Saving

4. Potential Explanations

Since demographic shifts related to changes in the relative sizes of cohorts did not seem to account for the decrease in household savings, next a variety of alternative hypotheses that could account for the deviations from the predictions of the traditional life cycle permanent income hypothesis are discussed. Some data and preliminary evidence of the quantitative relevance of these hypotheses in explaining the patterns are shown. First these hypotheses are investigated individually in order to ascertain their empirical relevance before turning to a framework that allows us to assess their relative importance.

4.1 Habit Formation

Habit formation implies that consumption reacts slowly to income change. This hypothesis has been used to explain why rapidly-growing countries have high saving rates but the evidence in favor of the hypothesis is weaker when applied to household data. In this paper, it is examined whether this hypothesis can explain the low household saving rate after high economic growth. Once households are accustomed to expanding their expenditure, it might take time for them to reduce the pace even if their wages do not increase any further.

Habit formation implies that current consumption growth is positively correlated with past consumption growth. Following Dynan (2000), the following equation was examined:

$$\Delta \log c_{i,t} = \alpha + \beta \Delta \log c_{i,t-1} + \gamma_i \theta_{i,t} + \varepsilon_{i,t}$$

where $\Delta \log c_{i,t}$ is the log-change in nondurables consumption for household *i* and $\theta_{i,t}$ is a vector of household characteristics. This regression was run using the panel of households. The sample was restricted to households whose heads were 25-59 years old, and excluded those where the heads were unemployed or waiting for an assignment. The following variables were also created; the log of nondurables consumption on time dummies interacted with dummies for residence; the age of household heads (5-year ranges); education, type of ownership of the workplace, sector of employment, and type of occupation of the heads, and demographic controls.

Table 2.10 presents the estimates for the coefficient on lagged consumption growth. The first sample covers the households in the 1998-2002 surveys for which cohort A and B are available. Initially this regression was estimated using OLS, controlling only the levels and changes in demographic variables such as age, age squared, the log of household size, and shares of household members in different age ranges. The estimated coefficient on lagged consumption growth was negative (-0.425). The second sample in Table 2.10 covers the households in 2003-2005 for which three cohort observations are available. The result was qualitatively similar to those in the first sample. That means, when households experienced consumption growth above average, it tended to have consumption growth below average in the following year, and vice-versa. The results were similar if residence, education and time dummies were added as controls. This pattern is the opposite of what one would expect in the presence of consumption habits.

There are two sources of potential bias in these OLS estimates--time averaging and measurement error (Chamon and Prasad 2008). If time averaging error is properly dealt with, it would presumably increase the

absolute magnitude of the negative coefficient on lagged consumption growth, which would in fact strengthen the evidence against habit formation. In order to address the measurement problem, the third lag of consumption growth is used as an instrument for the first lag. Since our second sample only covers three years, this specification can be used for the first sample only.

To summarize, our results suggested that habit formation could not account for the saving behavior of households. However, this evidence remained only suggestive since measurement problems in consumption could be driving these results, and the nature of the data limits our ability to more fully address this problem.

4.2 Shifts in Social Expenditure

Expenditure on education and health were significant parts of household consumption. Figure 2.32 shows how the expenditure on health and education varied over time for different age groups. Both were stable over time. Health expenditure accounted for a certain share of consumption expenditure over the age of the household heads. On the other hand, education expenditure peaked at around age 50 for the household heads, which could help explain low saving rates for that age group.

Owing to the public health insurance policy basically covering all citizens, the risk of health did not seem to be an important factor to change saving rates as before. On the other hand, education was still an influential factor to decide households' saving behavior. Since its expenditure was highly correlated to the share of children under 20 among all family members, its effects could be analyzed interpreting the coefficient of household components in the next section.

4.3 Durables Purchases and Savings

Even at present, consumer financing remains limited and controlled in Japan. As a result, instead of borrowing against future income to purchase durable goods, Japanese households are more likely to rely on their savings. This could cause households to postpone purchasing some of those desired goods and to save more in the process. The high saving rates among young households, in particular, may be driven by the desire to finance purchases of major consumer durables at a later date. These expenditure tend to be larger for younger households.

A measure of durables consumption was constructed using the detailed information on consumption expenditure available in the JPSC from 1998 to 2005. A regression of the household saving rate at time *t* on durable good purchases at time *t+1* suggested a negligible impact.

The lack of a relationship between savings and future purchase of durable goods was not surprising. On average, Japanese households spent 7 percent of their disposable incomes on durable goods in 2005. Most households could have financed such purchases just by saving less during that year, without needing to draw on past savings. Moreover, since a significant share of Japanese households' wealth is in liquid assets such as bank deposits, large purchases could be financed by drawing on those liquid savings.

4.4 Housing Purchases and Savings

One of the most important durable goods is housing. Table 2.11 shows the average home ownership rate for the households in our sample. The

proportion of households that own or partially own their homes increased from 51 percent in 1993 to 62 percent in 2005. Figure 2.32 plots average home ownership rates by age group. The home ownership rate among households was higher as their head got older over the study period. This ownership of the housing stock could help explain the change in household saving rates over age, since home purchase and construction expenditure were considered household savings. Table 2.11 also reports the ratio of home purchase and construction expenditure to disposable income.

That ratio of home purchase and construction expenditure to disposable income averaged at about 23.7 percent over the ten year period. It is estimated how much of those expenditure were financed by depleting past savings by computing the average of:

Min [Housing purchase and construction expenditure, Saving deposit withdrawals].

If a household did not have any housing purchase or construction expenditure in a given year, as is typically the case, this variable would equal zero. If the household had positive housing purchase and construction expenditure in that year, this variable would equal the lower of that expenditure and its savings withdrawals. Thus, this variable shows approximately how much of the observed housing purchase and construction expenditure could have been financed by saving withdrawals.

In order to gauge the magnitude of housing-related savings, the ratio of this variable including the majority of observations for which its value is zero to the average disposable income in that year was taken. This ratio suggested that in 1997 aggregate housing purchase related saving withdrawals corresponded to about 7.3 percent of aggregate household income, up from

3.6 percent in 1994. Of course, that ratio was much higher if households reporting non-zero home construction and purchase expenditure were only focused on. Due to data restriction, the ratios in other years were not obtained.

Table 2.11 also reports the ratio of the average repayment of home loans with respect to the average income. That ratio was lower in the early 1990s since many households' heads were young and had not bought their houses yet. Then, the ratio gradually went up and reached its peak in 2001-02 when many household's heads were in their 40s. In comparison with the change in this ratio, the ratio of housing loans to average income fluctuated less. In general, the Japanese financial institutes link the amount of repayment to debtors' income level. Unfortunately, interest payments amortization of principal on those loans could not be separated.

If home ownership motives were indeed an important contributor to savings, the high ownership rates that were attained in their 50s point to a decline in saving rates. Indeed, the saving rate declined in the late 40s and 50s. The empirical implications were explored in the next section. This discussion indicates that if households were able to tap their illiquid housing wealth, the need for precautionary savings would decline.

4.5 Effects of Employment Type on Saving Behavior

Changes in precautionary saving due to uncertainties stemming from the difference in employment type could potentially help explain the trend in saving. The high saving rates among young households may be driven by the need to build an adequate buffer stock of savings to smooth adverse shocks to their income. This factor could also explain why it was found that the higher saving cohorts were those that were in their 30s in 1993. These cohorts bore

much of the increase in uncertainty related to the changes in employment system and did not benefit from the life-long employment system and more non-regular employee positions.

Regular employment was likely to be more stable so, all else being equal, workers employed as a regular staff should save less. In the case of Japan, concerns related to the employment system could have contributed to an increase in saving rates of households reliant on regular employee income relative to other households. An implicit assumption underlying this argument is that the relative increase in uncertainty was greater for non-regular employees.

Table 2.12 shows that, among heads of household in the 25-59 age range, non-regular workers accounted for 1.9 percent of employment in 1993; this share had climbed to 5.9 percent by 2005. Hence, by comparing the savings of regular and non-regular households over time, it could be gauged whether the shift in employment patterns and the uncertainties could help account for the change in saving rates.

4.6 Target Savings

Another possible explanation for why Japanese household saving rates have changed is the target saving hypothesis. The basic idea is that households have a target level of saving that they want to achieve by the end of their working life, which means that saving rates will tend to be negatively correlated with the real returns on savings. This is just a way of restating the relative importance of substitution and income effects of changes in interest rates on intertemporal consumption decisions. The usual presumption is that

the substitution effect dominates, so that a lower real rate of return on savings leads to a lower saving rate.

It is difficult to test this hypothesis using time series data since the span of available data is limited and the economy underwent numerous changes over the survey periods. It is also difficult to test this at the household level since different households may face different rates of return on their savings, depending on the composition of their financial wealth. This information is not available in our dataset.

However, the vast majority of household financial savings takes the form of bank deposits and, since the deposit rate was closely related to the policy target rate, all households faced a similar nominal rate of return on their savings. The inflation rate is available only at the national level and in the Tokyo area, and those rates have a high correlation and assume the inflation rate was the same in Japan.

In order to investigate the effects of target savings, the log saving was regressed on the log of the gap of the difference and between the saving target and the current amount of saving, the real interest rate and age. The first regression was done with demographics controlled, and the second one was done with demographics, residence, and education controlled. In all regressions, the saving target gap had positive impacts on the saving rate. The saving rate increased by 0.05 to 0.1 percent once the amount of the target gap expanded one percent. On the other hand, the target saving rate did not have significant effect on the saving rate as previous studies pointed out in Japan.

These results should be interpreted with caution as there were many missing data among the samples. Furthermore, by t-test it was revealed that

the mean saving rate was significantly different between samples who reported their saving target and those who did not. People showing their saving targets had higher saving rates than those whose data is missing. Therefore, in our samples, it is difficult to say that the target saving hypothesis explained the saving behavior of Japanese households.

Table 2.10 Consumption Growth and Habit Formation

Type	Controls	Coefficient and S.E. on Lagged Non-durable Consumption Growth		Adjusted R2	Obs.
	Sample: Cohort A and B (1998-2002)				
OLS	Demographics	-0.425	0.082	0.207	5169
OLS	Demographics+Year	-0.425	0.082	0.207	5169
IV	Demographics+Year	-0.083	1.404	0.180	2815
OLS	Demographics+Region+Education+Year	-0.425	0.082	0.207	5169
IV	Demographics+Region+Education+Year	-0.109	1.434	0.212	2815
	Sample: Cohort A, B and C (2003-2005)				
OLS	Demographics	-0.252	0.105	0.127	1046
OLS	Demographics+Year	-0.252	0.105	0.127	1046
OLS	Demographics+Region+Education+Year	-0.251	0.104	0.137	1046

Table 2.11 Home Purchase and Construction Expenditure Financed by Saving Withdrawals

Year	Home Ownership (%)	Ave. Home Purchase Expenditure / Ave. Income (%)	Ave. of Min (Home purchase, Saving Withdrawals) / Ave. Income (%)	Ave. Repayment of Home Loans / Ave. Income (%)	Share of Households Repaying a Home Loan (%)	Ave. Housing Loan / Ave. Income Among Households Repaying Housing Loan (%)
1993	51.49	N/A	N/A	N/A	N/A	N/A
1994	54.62	28.3	3.6	4.6	25.31	16.5
1995	57.39	N/A	N/A	5.6	29.28	17.2
1996	59.23	N/A	N/A	6.3	31.22	18.2
1997	57.76	44.3	7.3	6.4	30.47	18.1
1998	58.56	16.9	N/A	7.1	31.95	19.7
1999	59.61	35.2	N/A	7.0	34.81	17.7
2000	61.95	18.8	N/A	7.5	36.58	17.7
2001	64.29	20.7	N/A	8.7	42.16	17.8
2002	66.45	32.9	N/A	9.7	42.31	20.6
2003	60.25	19.1	N/A	8.7	36.14	20.0
2004	61.49	13.1	N/A	7.6	37.32	17.4
2005	62.36	12.5	N/A	7.9	37.65	17.9

Table 2.12 Employment Type of Household Heads

Company Size	1993	1997	2003	2005
Regular worker	98.12	98.68	93.22	94.11
Non-regular worker	1.88	1.32	6.78	5.89

Table 2.13 Target Saving

Controls	Coefficient and S.E. on Log Target Saving Gap		Adjusted R2	Obs.
Sample: Cohort A (1993-2005)				
Demographics	0.055	0.017	0.417	1168
Demographics+Region+Education+Year	0.055	0.017	0.440	1168
Sample: Cohort A and B (1997-2005)				
Demographics	0.049	0.021	0.420	847
Demographics+Region+Education+Year	0.052	0.020	0.449	847
Sample: Cohort A, B and C (2003-2005)				
Demographics	0.087	0.037	0.410	277
Demographics+Region+Education+Year	0.098	0.039	0.442	277

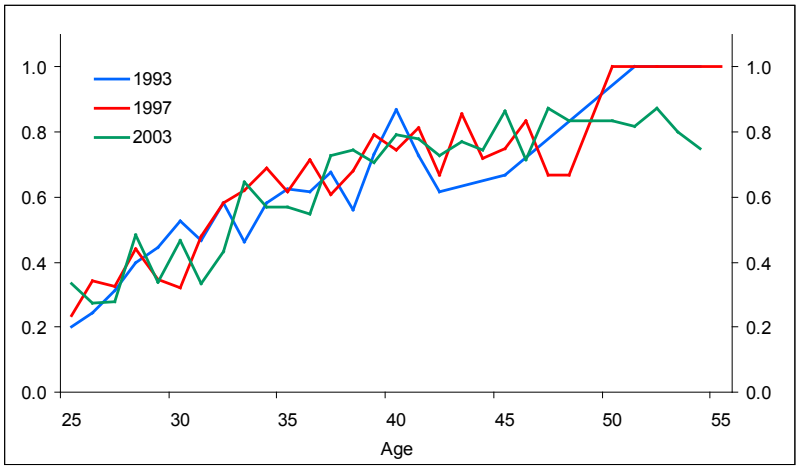


Figure 2.31 Home Ownership by Age of the Head of Household

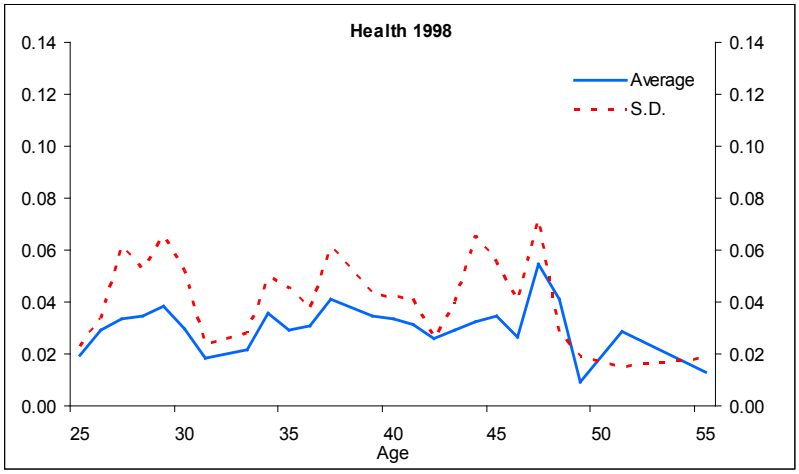
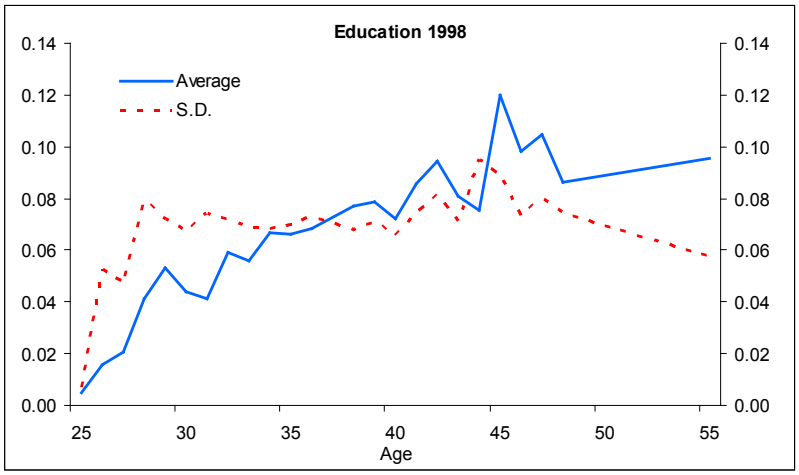
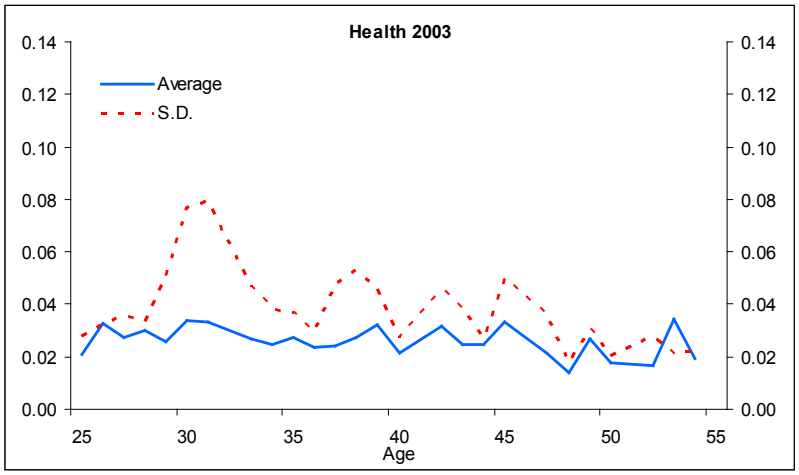
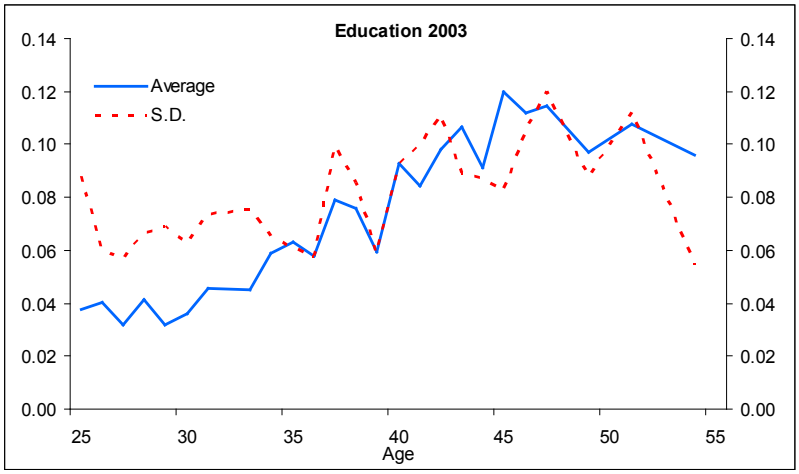


Figure 2.32 Average and Standard Deviation of the Shares of Consumption Expenditure on Education and Health as a Function of Age of the Head of the Household

Figure 2.32 (Continued)







5. Composite Sketch

An estimation framework for jointly analyzing the importance of some of the key hypotheses in driving the decrease in the household saving rate was developed. The evidence in the last section suggests that the savings for durable purchases, consumption persistence due to habit formation, and target savings behavior were not major contributors to the saving behavior. Hence, the other motives for saving that seem quantitatively most relevant, i.e. housing purchases, and the change in employment type, are focused on. Education costs were also a very important factor to influence the saving behavior, but this was closely related to the household demographics and its contribution was examined through the demographic effects.

Composite median regressions for the household saving rates using the following controls were estimated:

Demographics: The dummies were the age of the heads of household's being 25-29, 30-34, ..., 50-54, and 55-59 years old, the log of the household size, and the share of household members aged 0-4, 5-9, 10-14, 15-19, 20-59, and 60 or above. These controls could inform us of how the presence of the elderly and children of different ages affected savings, helping us to gauge saving motives related to future expenditure on health and education.

Income: The log of disposable income was included. Dummies for education, occupation, industry of the household head, residence and year dummies were also included. These dummies could capture the permanent income of a household with some given characteristics. Thus, when reading the coefficient on log income, one should bear in mind that the estimated effect included these other controls.

Employment type: This effect was captured by one dummy. The variable equals one if the household head was employed as a non-regular worker. This specification allowed us to capture possible nonlinearity in the effect.

Home ownership: A dummy equal to one if the household owned its dwelling.

Table 2.14 presents the regression results. To abstract from year-to-year variations, the results were for the following periods: 1993-96, 1997-2002 and 2003-05. For each period, the results from a specification including only the income, and demographic controls, year and residence dummies were presented first. Then a second specification that also controlled employment type, and home ownership were investigated.

It is worth noting that the estimated year dummies, not reported in the table for presentation purposes, did not imply any kind of trend.

The effect of income on the saving rates grew stronger over time. All else being equal, a one percent increase in disposable income increased saving rates by 0.4 to 0.5 percentage points in 2003-05 up from about 0.2 in 1993-1996. This higher saving propensity of richer households might seem like a promising explanation for the behavior in savings. But one should keep in mind that this coefficient was capturing the effect of income after controlling a host of household characteristics such as education, occupation, residence, year, among others, so one could not simply multiply this coefficient by income changes to read an effect on the saving rate. But this rising coefficient does suggest that, all else being equal, households tended to save more of the idiosyncratic components of their income, which is consistent with stronger precautionary saving motives.

The age dummies confirm that households with relatively very young or very old heads tended to save less, although the magnitude of the difference in savings was more muted than the age effects estimated in the last section. This suggests other controls might capture the differences by age shown in those plots.

While controls directly related to education expenditure were not included, their importance could be gauged by the household composition controls. For example, we could compare households with children aged 5-9 and 10-14 years with those aged 15-19 for which education expenditure tend to be higher. All else being equal, the difference in the savings between a three person household with one child in the 5-9 age group and one with a member in the 15-19 age group in 1993-96 was muted, and it was about 2 percentage points in 2003-05. If we compare the 10-14 with the 15-19 age group, the difference was negligible in 1993-96 and 1.4 percentage points in 2003-05. This pattern was consistent with higher savings in anticipation of future education expenditure. Although households with children tended to have savings for the expected education cost, the expenditure seemed to exceed their saving because the coefficients of those households were all negative.

As discussed earlier, differentials in saving rates between regular workers and non-regular workers were used to tease out the magnitude of precautionary motives for saving. Our maintained assumption was that, while overall macro uncertainty increased and the level of uncertainty might be higher in the private sector, the relative increase in uncertainty was greater for non-regular employees. Having a non-regular employee in the household did not have a significant impact on the saving rate over all periods. This can

suggest that although the household whose head was a non-regular worker had more uncertainty in the future, they did not have higher motivation for precautionary savings. This might be because the social safety net was good and reduced non-regular workers' fluctuation in their wages. Since the survey did not have expected wages when the samples became unemployed, it was difficult to analyze the impact of non-regular employment on the saving further.

Finally, the home ownership dummy was investigated. Households that own their homes saved about 1 percentage points more of their income in 1993-96 and 1997-2002 than those that did not. The sign was the opposite of what one would expect based on our contention that households saved for house purchases. This effect increased to 2 percent in the 2003-05 sample.

The first panel of Table 2.15 presented estimates for the same regressions as the ones above, but with income and consumption adjusted by an estimated value of owner-occupied housing obtained by regressing. For the sample of renters, rent expenditure on non-rent consumption expenditure, demographic controls, province and non-regular employment dummies were adjusted. Then using the fitted values to impute rents for the homeowners were adopted. The data was bootstrapped to construct the standard errors. Now the effect was minus 2 percentage points for 1998-2002 and minus 1 percent for 2003-05. Then, dummies for value quartiles by residence and year were created. However, any significant difference in coefficients among those values was not indicated.

The effects of home ownership on savings might depend on the age of the household heads. For example, a young household head who did not own a dwelling was more likely than to be saving to purchase one a 65 year old. The second panel of Table 2.15 presents regressions similar to those of the

first panel, but with interactions of the home ownership dummy with dummies for five year ranges of the age of the household head. Home ownership had a negative effect on saving rates in 1998-2002, and the coefficient on the age interactions indicates that owing houses reduced the saving rate of young households. Home ownership had a positive effect on saving rates in 2003-05 but it was not significant, and the coefficients on the age interactions were not statistically significant, either.

In that sample, the coefficient on the home ownership dummy was -2.4 percentage points. The coefficients on its interaction with age were still negative, and the combined effect gradually declined from the 25-29 age group towards older households. The point estimates imply effects of -4.8, -2.3, and -0.9 percentage points for 30-34, 35-39 and 40-44 year old household heads, respectively. The point estimates still imply a negative effect for 45-49 year old household heads, and a positive effect for the older households. Thus if the ratio of homeownership among young households climbed, then the saving rates among them reduced. Similarly, if the ratio of homeowners among old households dropped, the saving rates went down.

Table 2.14 Median Regressions for the Saving Rate

	1993-1996		1997-2002		2003-2005	
	(1)	(2)	(3)	(4)	(5)	(6)
Log Income	0.023	0.020	0.032	0.032	0.048	0.043
	0.007	*0.007*	*0.005*	*0.004*	*0.006*	*0.005*
Non-regular Worker		-0.029		-0.034		-0.005
		0.021		*0.014*		*0.010*
Owns Home		0.014		0.007		0.019
		0.007		*0.004*		*0.005*
Age 30-34	0.002	0.001	0.018	0.018	0.010	0.005
	0.008	*0.008*	*0.006*	*0.006*	*0.009*	*0.007*
Age 35-39	0.016	0.014	0.025	0.024	0.006	0.001
	0.009	*0.009*	*0.007*	*0.006*	*0.009*	*0.008*
Age 40-44	0.022	0.016	0.031	0.030	0.012	0.005
	0.012	*0.011*	*0.008*	*0.007*	*0.010*	*0.008*
Age 45-49	-0.009	-0.010	0.033	0.033	-0.001	-0.011
	0.022	*0.021*	*0.010*	*0.008*	*0.012*	*0.010*
Age 50-54	-0.003	-0.003	0.003	0.003	-0.006	-0.021
	0.041	*0.040*	*0.018*	*0.016*	*0.016*	*0.013*
Age 55-59	-0.048	-0.050	-0.025	-0.030	-0.004	-0.014
	0.084	*0.081*	*0.035*	*0.030*	*0.041*	*0.034*
Log Household Size	0.059	0.057	0.072	0.070	0.058	0.051
	0.011	*0.012*	*0.008*	*0.007*	*0.009*	*0.008*
Share aged 0-4	-0.128	-0.126	-0.120	-0.118	-0.073	-0.064
	0.025	*0.025*	*0.019*	*0.017*	*0.026*	*0.021*
Share aged 5-9	-0.203	-0.202	-0.169	-0.167	-0.110	-0.104
	0.026	*0.025*	*0.018*	*0.016*	*0.025*	*0.020*
Share aged 10-14	-0.222	-0.216	-0.190	-0.188	-0.126	-0.115
	0.034	*0.034*	*0.020*	*0.017*	*0.025*	*0.021*
Share aged 15-19	-0.178	-0.212	-0.255	-0.254	-0.172	-0.155
	0.087	*0.084*	*0.026*	*0.023*	*0.030*	*0.025*
Share aged Above 60	0.007	-0.016	-0.001	-0.010	0.055	0.052
	0.031	*0.030*	*0.021*	*0.019*	*0.028*	*0.023*
Observations	4128	4128	7151	7151	4226	4226

Table 2.15 Median Regressions for the Saving Rate Including Imputed Value of Owner-Occupied Housing

Dummy for Home Ownership

	1998-2002	2003-2005
	(1)	(2)
Log Income	0.084	0.081
	0.007	*0.008*
Owns Home	-0.024	-0.012
	0.005	*0.006*
Observations	5865	4232

Table 2.15 (Continued)

Dummy for Home Ownership Interacted Age Dummies

	1998-2002	2003-2005
	(1)	(2)
Log Income	0.083	0.083
	0.007	*0.010*
Owns Home	-0.024	0.008
	0.011	*0.010*
Owns Home*Age 30-34	-0.024	-0.031
	0.015	*0.018*
Owns Home*Age 35-39	0.001	-0.028
	0.015	*0.014*
Owns Home*Age 40-44	0.015	-0.013
	0.014	*0.011*
Owns Home*Age 45-49	-0.006	-0.010
	0.023	*0.018*
Owns Home*Age 50-54	-0.012	-0.050
	0.063	*0.042*
Owns Home*Age 55-59	0.331	-0.142
	0.080	*0.129*
Observations	5865	4232

6. Conclusion

The researched question is what causes the aggregate household saving in Japan to go down, and what kind of changes happened to people's saving behavior. Under low income growth and prospects of sustained low income growth, the aggregated household saving rate in Japan dropped by about 10 percentage points over the period 1993-2005. It was found that the life-cycle model did not adequately explain the change in the aggregate household saving rate in Japan with respect to the change in the population structure. The ratio of aged population to production-age population is increasing rapidly and by the time series analysis, it showed that, in fact, the increase in the aged population ratio had a negative impact on the household saving rates. This partially explains the recent sharp decrease in the household saving rate in Japan's aging society and is consistent with the life-

cycle model. On the other hand, according to the life-cycle model, the increase in the ratio of child population leads to a decrease in the household saving rate. However, the result of the time series analysis shows that the impact of the increased child population ration was ambiguous.

By using panel data, after controlling time and cohort effects, a hump-shaped age-savings profile was found, with households headed by young persons and those headed by old persons having low saving rates and those headed by the middle aged having the highest saving rates.

Taken at face value, the estimated age profile of savings suggests negative changes in the saving rate as Japan's population ages since the old had among the low saving rates. Combining our estimated age-profile of savings for the 25-59 age group with the evolution of the Japanese population implies the further decrease in the aggregated saving rate.

Habit formation considerations could in theory help explain the decline in saving rates after high economic growth, but evidence was not found supporting that channel. The savings driven by the motive of home ownership could partly account for the decrease in the household saving rate from 1993 to 2005, when the decrease in having home among old households reduced the aggregated household saving rates. Within our composite regression framework, a comparison of saving behavior between households that own their dwellings and those that rent suggests the important role of this factor.

The increasing burden of education expenditure seemed among the strongest candidates for explaining the change in saving rates. Our estimates show that the increase in the proportion of the family members under the age of 20, which had high positive correlation with the education expenditure, could largely explain the decrease in saving rates among households. In

addition, because more and more households did not live together with their aged parents, the household size itself was shrinking, which had a negative effect on saving rate.

Finally, some weak indirect evidence in support of the target saving hypothesis was found, whereby Japanese households had lower saving rates because they were targeting a lower level of wealth and the real return on their savings, most of which went into bank deposits, had a small effect.

Although there were limits to conduct the analysis using this dataset, it can be said that the changes in the population structure and the ones in the household saving behavior both were important factors in drastically decreasing the aggregated household saving rates in Japan.

APPENDIX

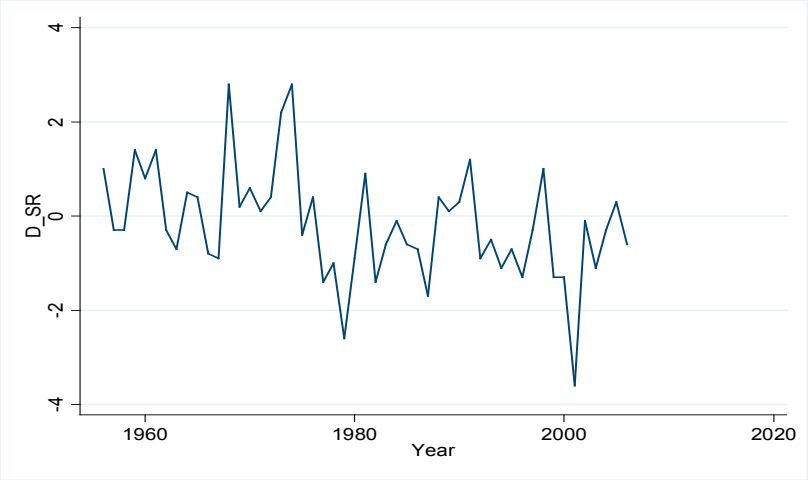


Figure 2.A.1 Saving Rate in the First Difference

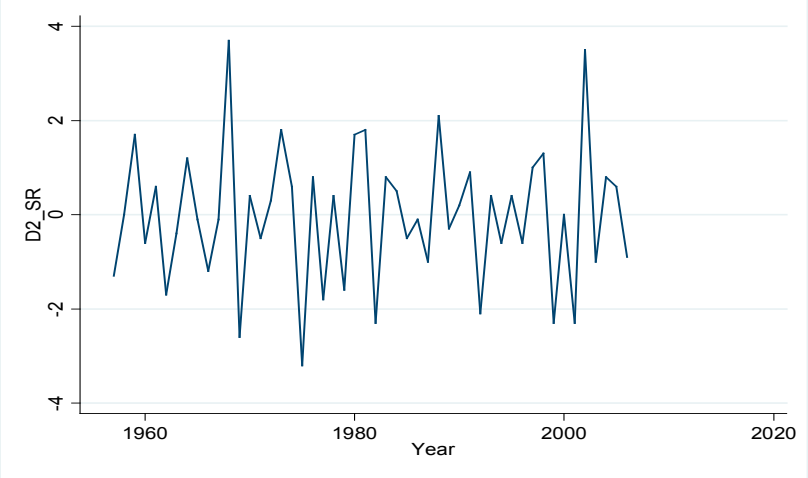


Figure 2.A.2 Saving Rate in the Second Difference

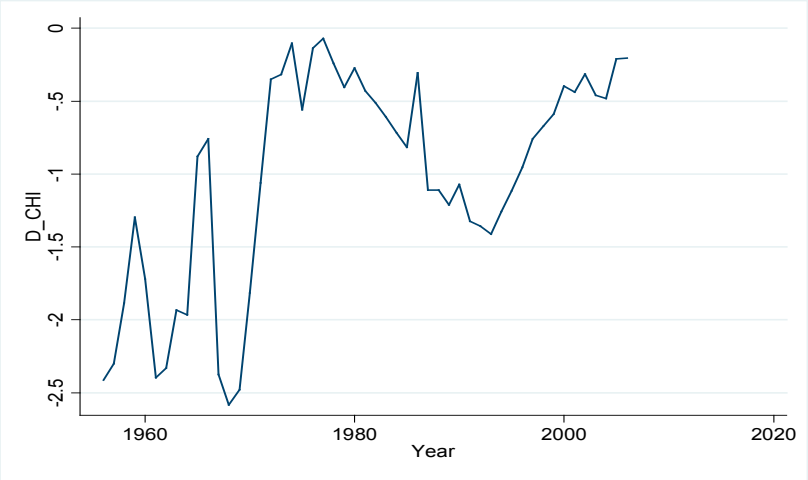


Figure 2.A.3 Ratio of Child Population to Productive-Age Population in the First Difference

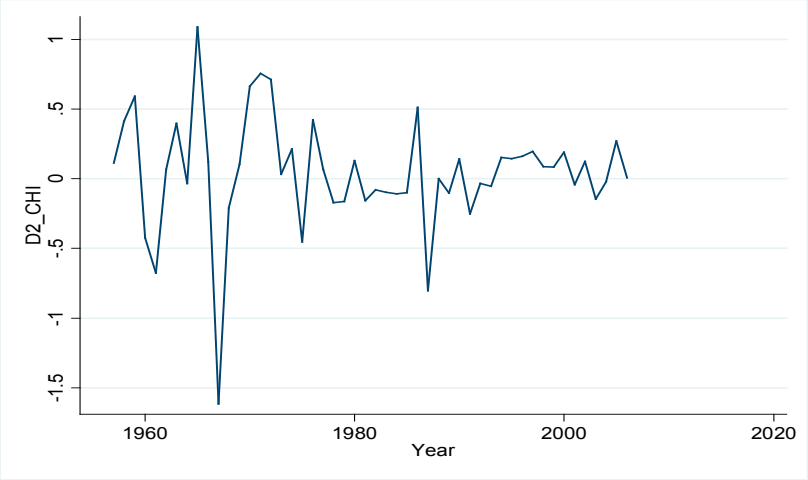


Figure 2.A.4 Ratio of Child Population to Productive-Age Population in the Second Difference

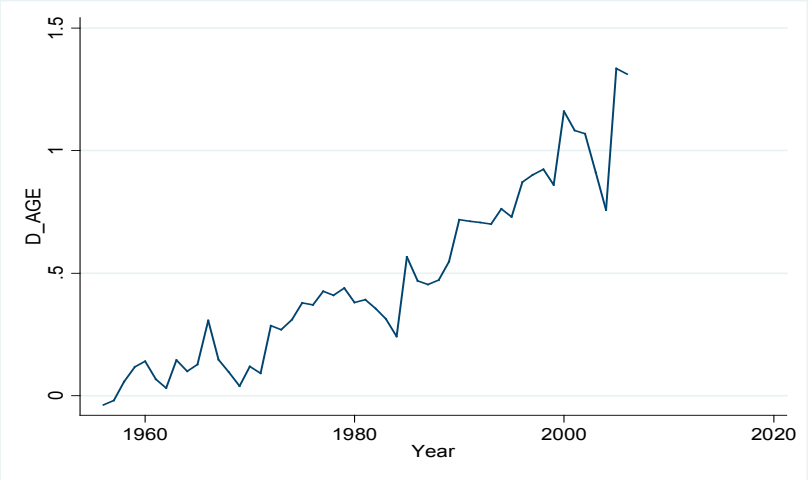


Figure 2.A.5 Ratio of Aged Population to Productive-Age Population in the First Difference

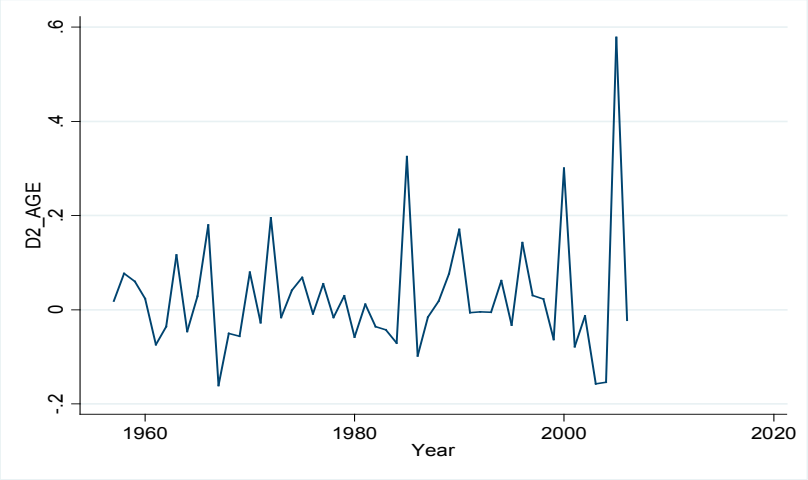


Figure 2.A.6 Ratio of Aged Population to Productive-Age Population in the Second Difference

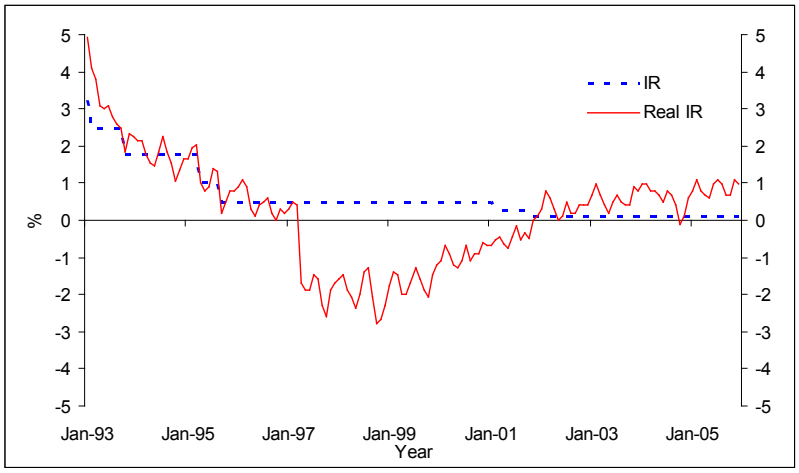


Figure 2.A.7 Nominal and Real Policy Target Rate (1993 CPI index=100)

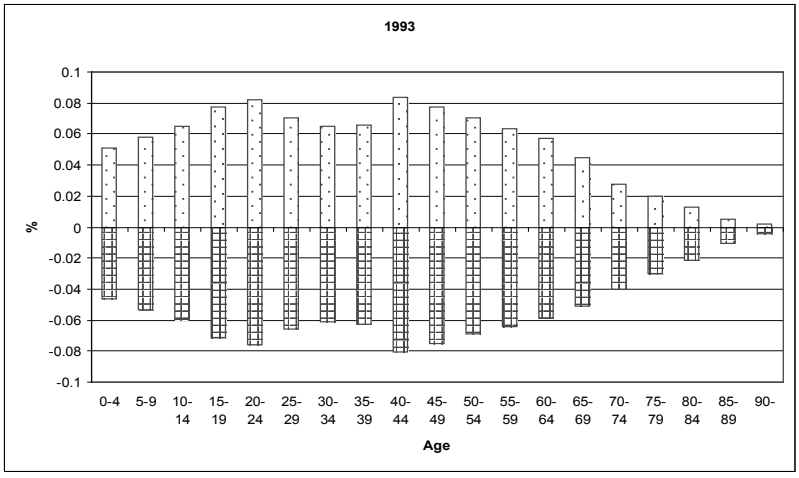


Figure 2.A.8 Demography in 1993

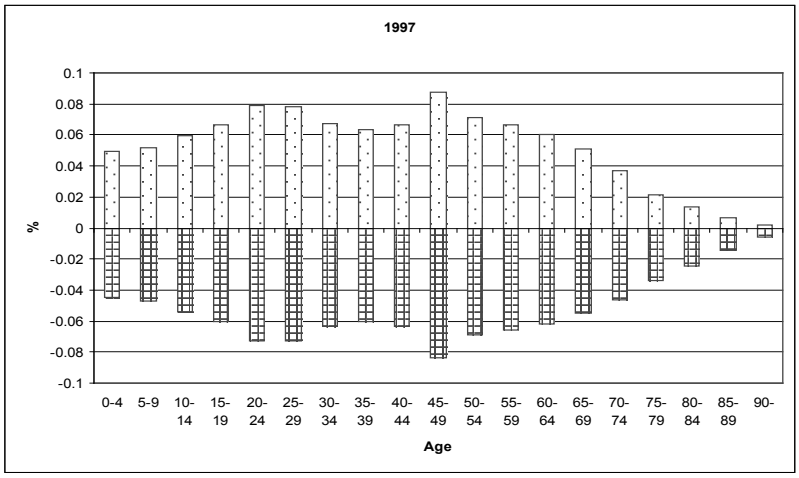


Figure 2.A.9 Demography in 1997

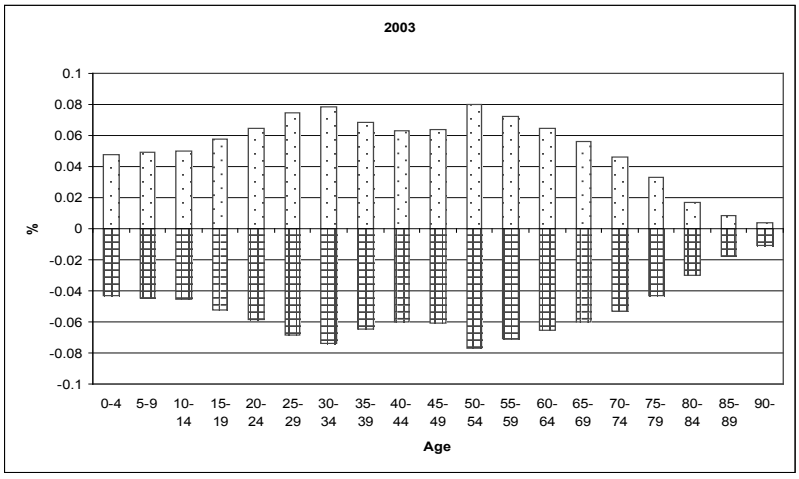


Figure 2.A.10 Demography in 2003

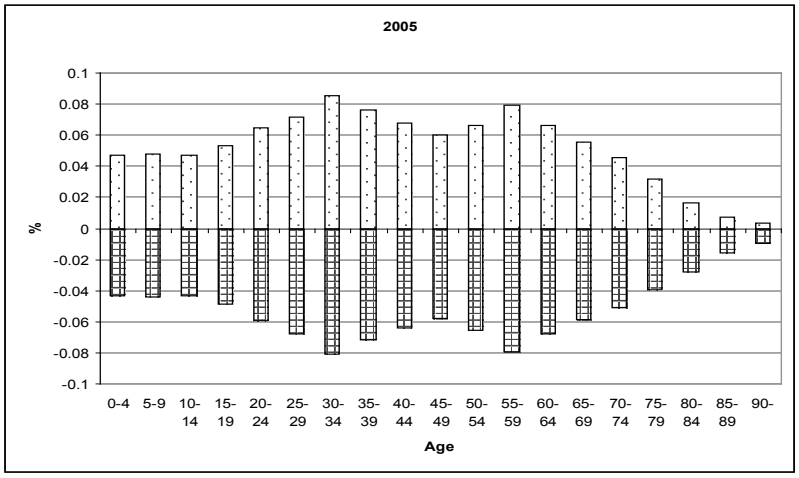


Figure 2.A.11 Demography in 2005

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CHAPTER 3

INTRA-HOUSEHOLD INCOME ALLOCATION IN JAPAN

1. Introduction

The multi-person household is sometimes treated as a single unit. The adoption of the unitary model is convenient but it does not necessarily have a strong theoretical background. In addition, previous empirical studies indicate that this unitary model does not hold in many cases. This paper analyzes whether the collective model suggested in Chiappori explains the household allocation pattern in Japan. This model makes two assumptions. One is that each person in the household has his or her own preferences and the other is that collective decisions are Pareto efficient. Under these assumptions, the model by Browning and Chiappori (1998) is reviewed and then the conditions on a sample of Japanese households are tested.

The first model to describe household behavior as a collective process was developed by Becker in his seminal work (1991). Bourguignon (1984) and Pollak (1995) emphasized that a multi-person approach might lead to violations of the predictions from the unitary model. Since then, several models have been established to explain intra-household decision making as a cooperative process. One of them is the Nash bargaining representation of family decisions by Manser and Brown (1980) and McElroy and Horney (1981). This approach has two main concepts. One is that household demands should be sensitive to the intra-household distribution of resources. The other is that the repeated rejections of Slutsky symmetry in empirical work may happen because household decisions cannot be crammed into a restrictive unitary

framework. Browning and Chiappori's model developed this Nash-bargaining framework.

A household is a good example of a repeated game so it is justified to assume that each person knows the preference of the other members in the family. Thus, cooperation for utilizing earnings often can be a long-term equilibrium of repeated noncooperative frameworks. In addition, efficiency is probably the most natural generalization to the multi-person setting of utility maximization in standard models. Hence, the conditions Browning and Chiappori drove generalize Slutsky symmetry. Finally, axiomatic models of bargaining with symmetric information assume efficient outcomes.

2. Theory

2.1 General Case

2.1.1 The collective Setting

According to Browning and Chiappori, although Slutsky symmetry does not need to hold in the collective setting, it can be generalized that the Slutsky matrix has to be equal to the sum of a symmetric matrix and a rank one matrix. They also showed that the collective model implies that there is a close relationship between the influence of variables that do not enter individual utilities directly but that affect distribution within the household, on demand and price responses. The preference behaved in the following way;

Axiom 1: Member *I*'s (*I* = *A, B*) preferences can be represented by a utility function in the form $u^I(\vec{q}^A, \vec{q}^B, \vec{Q})$ that is strongly concave and twice differentiable in $(\vec{q}^A, \vec{q}^B, \vec{Q})$, and strictly increasing in $(\vec{q}^I, \vec{Q})$.

where $\vec{q}^{\,A}$ and $\vec{q}^{\,B}$ are private consumption by *A* and *B*, and $\vec{Q}$ is public consumption. Then, efficiency is postulated as follows;

Axiom 2: The outcome of the household decision process is a Pareto efficient, meaning for any price-income bundle $(\vec{p},x)$, the consumption vector $(\vec{q}^{\,A},\vec{q}^{\,B},\vec{Q})$ chosen by the household is such that no other vector $(\vec{q}^{\,A},\vec{q}^{\,B},\vec{Q})$ in the budget set could make both members better off.

Following Chiappori (1992), the models that allow for different preferences with efficiency are referred to as the collective setting. Finally, some structure is added by assuming the following axiom;

Axiom 3: There exists a differentiable, zero-homogeneous function $\mu(\vec{p},x)$ such that, for any $(\vec{p},x)$, the vectors $(\vec{q}^{\,A},\vec{q}^{\,B},\vec{Q})$ are solutions to the program;

$$\max_{q^A,q^B,Q} \mu(\vec{p},x)\cdot u^A(\vec{q}^{\,A},\vec{q}^{\,B},\vec{Q})+[1-\mu(\vec{p},x)]\cdot u^B(\vec{q}^{\,A},\vec{q}^{\,B},\vec{Q}) \qquad (1)$$

subject to $\vec{p}\cdot(\vec{q}^{\,A}+\vec{q}^{\,B}+\vec{Q})=x$.

where $\vec{p}$ is a price vector and *x* is total expenditure. Any point on the Pareto frontier can be obtained by solving this program. This axiom premises that there exists a demand function. Here, (i) the assumption is consistent with our general framework, which postulates efficiency. In addition, (ii) assuming the existence of a demand function is not extremely restrictive. Most work on demand uses a similar assumption.

Two additional points should be noted at this moment. One is μ may also depend on other factors, such as the individual incomes of the two partners. The other is the assumption that preferences are identical is made.

The function $q(\vec{p},x)$ meets the following propositions;

Proposition 1: Assume that $q(\vec{p},x)$ is compatible with collective rationality, meaning that there exist functions $q^A(\vec{p},x), q^B(\vec{p},x), Q(\vec{p},x)$, solution of a program (1), such that $q(\vec{p},x) = q^A(\vec{p},x) + q^B(\vec{p},x) + Q(\vec{p},x)$. Then it is zero-homogeneous, continuously differentiable, and satisfies $p'q(\vec{p},x) = x$.

Next, the household utility function is defined as follows.

Definition 1: In the collecting setting, the household utility function is defined as

$$u^H(\vec{q},\mu) = \max_{q^A,q^B,Q} \mu(\vec{p},x)\cdot u^A(\vec{q}^A,\vec{q}^B,\vec{Q}) + [1-\mu(\vec{p},x)]\cdot u^B(\vec{q}^A,\vec{q}^B,\vec{Q})$$

subject to $\vec{q}^A + \vec{q}^B + \vec{Q} = \vec{q}$.

2.1.2 Dual Representatives of the Collective Program

Given the utility function for the two people, a dual representation of household preferences can be defined. First, define the household indirect function as the initial optimization problem above is as follows;

$$V(\vec{p},x,\mu) = \max_{q^A,q^B,Q} \mu\cdot u^A(\vec{q}^A,\vec{q}^B,\vec{Q}) + [1-\mu]\cdot u^B(\vec{q}^A,\vec{q}^B,\vec{Q}) \quad (2)$$

subject to $\vec{p}\cdot(\vec{q}^A + \vec{q}^B + \vec{Q}) = x$.

The corresponding expenditure function is defined as;

$$E(\vec{p},u,\mu)=\min_{q^A,q^B,Q}\vec{p}\cdot(\vec{q}^{\,A}+\vec{q}^{\,B}+\vec{Q})=x\,. \tag{3}$$

subject to $\mu\cdot u^A(\vec{q}^{\,A},\vec{q}^{\,B},\vec{Q})+[1-\mu]\cdot u^B(\vec{q}^{\,A},\vec{q}^{\,B},\vec{Q})\geq u\,.$

By the duality between (2) and (3), the following equation is obtained,

$$\partial f_i/\partial p_j+\partial f_i\cdot f_j/\partial x=\partial h_i/\partial p_j$$

where $q=f(\vec{p},x,\mu)$ is the solution of the program (2) and $h(\vec{p},u,\mu)$ is the solution of (3). The matrix Σ with general form

$$\sigma_{ij}=\partial f_i/\partial p_j+\partial f_i\cdot q_j/\partial x$$

can be interpreted as the partial derivatives of demands with respect to prices, holding both household utility and μ constant.

2.1.3 Restrictions on Demands

Now restrictions on various demands for consumption goods are investigated. For any given price-income bundle $(\vec{p},x)$, the behavior that is observable corresponds to one specific value of μ. What is observable is the demand function ξ defined by

$$\xi(\vec{p},x)=f(\vec{p},x,\mu(\vec{p},x))\,.$$

In the collective model, the following characteristics are established;

Proposition 2: The Pseudo-Slutsky matrix *S* is the sum of a symmetric and negative semi-definite matrix Σ and outer product:

$$S = \Sigma + uv'$$

where u and v are n-vectors with

$u_i = \partial f_i / \partial \mu$ and $v_j = \partial \mu / \partial p_i + \partial \mu / \partial x \cdot \xi_j$.

This formula means that assuming that the price of good *j* is changed by dp_j, the change is compensated by an increase in income $dx = q_j \cdot dp_j$. This explains that the change in price can be decomposed into a substitution effect and a wealth effect.

The following corollary mentions a useful consequence;

Corollary 1 (SR1 Property): In the collective setting, the pseudo-Slutsky matrix *S* is the sum of a symmetric, negative semi-definitive matrix Σ and a matrix *R* that has at most rank one.

This condition generalizes the unitary model where *R*=0.

2.1.4 Testing for SR1

Following the above, the proposition underlining the empirical analysis is as follows;

Proposition 3: Let *S* denote the pseudo-Slutsky matrix, and let *M*=*S*-*S'*. Then, in the collective setting:

(i) *M* has rank zero and two.

(ii) If *M* has rank zero, the unitary case cannot be ruled out.

(iii) If *M* has rank 2, then $M = uv' - vu'$ for two vectors u and v that span Im(*M*), which represents the subspace spanned by the columns of *M*. Moreover, for any vector w orthogonal to Im(*M*), then $w'Sw \leq 0$.

Also, given the homogeneity assumption, one needs at least five commodities to test the SR1 property.

2.2 Extension of the Theory

Now the theory is extended to three models. The first extension allows for households to have more than two members. The second allows variables that affect the distribution function μ but not preferences directly. The third extension puts some restrictions on the way prices enter μ.

2.2.1 Multiple-member model

If there are more than two people in the family, then the class of demands admitted in the collective setting is generally wider. The conditions are given as follows;

Proposition 5: Assume that the family has *k*+1 members where *k*<*(n-1)*. In the collective setting the Pseudo-Slutsky matrix *S* is the sum of a symmetric matrix and a matrix of rank no lager than *k* (SR*k*).

One possible application is to households with children. In the multi-person model, if there are as many people as goods minus one, then the collective setting does not impose any restrictions on demand as follows;

Proposition6: Suppose that the household has at least *(n-1)* members. For any finite set of prices and demands, preferences for which observed behavior is compatible with the collective setting can be found.

2.2.2 Allowing Distribution Factors

The next extension to the basic model is the inclusion of factors that affect the distribution function $\mu(\vec{p}, x)$. First, the case with a single distribution factor *y* is included so that $\mu = \mu(\vec{p}, x, y)$. This means that *y* only joins the household utility function through the same index as prices and total expenditure: $u = u(\vec{q}, \mu(\vec{p}, x, y))$. Household demands take the form $\xi(\vec{p}, x, y) = f(\vec{p}, x, \mu(\vec{p}, x, y))$. Denoting the gradient of demands to changes in *y* by ξ_y, this factor can affect demands in the following manner;

Proposition 7: In the collective setting, there are following equivalent conditions:

(i) The Pseudo-Slutsky matrix takes the form $S = \Gamma + \xi_y v'$ where Γ is symmetric.

(ii) ξ_y can be expressed as a linear combination of the columns *(S-S')*.

Since *S* and the vector ξ_y are observable, condition (ii) can be used to test for this restriction. If more distribution factors are added so that *y* is a

vector, then the collective setting imposes further restrictions. Bourguignon (1993) proved that:

Proposition 8: In the collective setting, there are:

$\xi_{y_i} = \theta_i \xi_{y_i}$, for all $i \geq 2$, where $\theta_i \in R$.

2.2.3 Restricting the Dependence of Distribution on Prices

Third, an alternative structure can be imposed on the distribution function μ. Suppose that prices are restricted to enter μ only through a known linear homogenous price index $\pi(p)$. In addition, prices and income can be normalized in the same way. Let P_i, X, Y denote real variables;

$$P_i = p_i / \pi(\vec{p}) \ , \ X = x / \pi(\vec{p}) , \ Y = y / \pi(\vec{p}) .$$

Then, demands can be expressed as functions of real variables:

$$\xi_i(\vec{p}, x, y) = \xi_i(\vec{p} / \pi(\vec{p}), x / \pi(\vec{p}), y / \pi(\vec{p})) = \xi_i(P, X, Y) .$$

Consequently, the following proposition can be obtained.

Proposition 9: It there is only a single distribution factor and $\mu = \mu(X, Y)$, then the Pseudo-Slutsky matrix takes the form: $S = \Gamma + k\xi_y \xi'$ where *k* is a constant.

Because the two components of the outer product on the right hand side can be observed, this gives a test of the collective model with a known linear homogeneous price index and a single distribution factor.

3. A Parametric Demand System

In this section, a parameterization for the demand system is considered and the implications of the restrictions implied by the collecting setting are derived.

3.1 Quadratic Log Demand System

The Quadratic Almost Ideal Demand System (QUAIDS) of Banks, Blundell, and Lewbel (1992) is the starting point. The budget share n-vector *ω* is modeled as a function of log prices and log total expenditure. *p* is the n-vector of log prices and *x* is total expenditure. The QUAIDS demand system is;

$$\vec{\omega} = \vec{\alpha} + \Gamma\vec{p} + \vec{\beta}(\ln x - a(\vec{p})) + \vec{\lambda}(\ln x - a(\vec{p}))^2 / b(\vec{p}) \qquad (4)$$

where $\vec{\alpha}$, $\vec{\beta}$, and $\vec{\lambda}$ are n-vectors of parameters and Γ is an n×n matrix of parameters. The prices $a(\vec{p})$ and $b(\vec{p})$ are defined as

$$a(\vec{p}) = \alpha_0 + \vec{\alpha}'\vec{p} + 0.5\vec{p}'\Gamma\vec{p}$$
$$b(\vec{p}) = \exp(\vec{\beta}'\vec{p}) .$$

Homogeneity is imposed in the following cases and n is the number of goods minus one. $(\vec{\alpha}, \vec{\beta}, \vec{\lambda})$ and Γ are reduced vectors and matrices.

The Pseudo-Slutsky matrix for the parameterization is derived;

$$S = \vec{\omega}_p + \vec{\omega}_x \vec{\omega}'$$

where $\vec{\omega}_p$ is the n × n Jacobian matrix of partial derivatives of the budget shares with respect to log prices and $\vec{\omega}_x$ is the gradient of $\vec{\omega}$ with respect to ln*x*. Applying this to the previous equations gives

$$S = \Gamma - 0.5(\vec{\beta} + 2\vec{\lambda}\tilde{x} / b(\vec{p}))\vec{p}'(\Gamma - \Gamma') + \tilde{x}(\vec{\beta}\vec{\beta}' + (\vec{\lambda}\vec{\beta}' + \vec{\beta}'\vec{\lambda})\tilde{x} / b(\vec{p}) + \vec{\lambda}\vec{\lambda}'(\tilde{x} / b(\vec{p}))^2)$$

where $\tilde{x} = \ln x - a(\vec{p})$.

3.2 Testing for Implications of the Collective Model

The necessary and sufficient condition for symmetry and symmetry plus one (SR1) for our parameterization is;

Proposition 10: *S* is SR1 for all $(\vec{p}, x)$ iff Γ is SR1.

Including the preference factors by allowing them to modify the parameters of the indices $a(\vec{p})$ and $b(\vec{p})$;

$$a(\vec{p}, z) = \alpha_0 + \alpha(\vec{z})'\vec{p} + 0.5\vec{p}'\Gamma\vec{p}$$

and

$$b(\vec{p}, z) = \exp(\beta(\vec{z})'\vec{p})$$

In our parameterization, *a(z)* and *b(z)* are taken to be linear;

$$\alpha(\vec{z}) = \alpha^0 + \alpha^1 z_1 + \cdots + \alpha^{l_\alpha} z_{l_\alpha}$$

where l_α is the number of preference factors included in the α( ) term and the α^k 's are n-vectors. Similarly,

$$\beta(\vec{z}) = \beta^0 + \beta^1 z_1 + \cdots + \beta^{l_\beta} z_{l_\beta}$$

To incorporate the distribution factors, it is convenient to include the distribution factors in the constant tern in (4);

$$\vec{\omega} = \alpha(\vec{z}) + \Theta\vec{y} + \Gamma\vec{p} + \beta(\vec{z})(\ln x - a(\vec{p},\vec{z})) + \vec{\lambda}(\ln x - a(\vec{p},\vec{z}))^2 / b(\vec{p},\vec{z}) \qquad (5)$$

where *y* is an m-vector of distribution factors and *Θ* is an $n \times m$ matrix of parameters.

The next condition is the distribution factor proportionality condition given in Proposition 8. This is tested by testing for the following condition on the columns of *Θ* ;

$\Theta^k = \tau_k \Theta^1$ for $k \geq 2$.

If this condition and SR1 are not rejected, then the distribution factor linearity can be tested. Denoting the *i*th column of *M* as M^i , the joint test for distribution factor proportionality and linearity is formulated;

$$\Theta = (M^1 \quad M^2) * (\lambda_1\tau \quad \lambda_2\tau)'$$

This restriction have *m(n-2)-1* degrees of freedom.

Now the tests are presented for symmetry, symmetry plus rank one, distribution factor proportionality, and distribution factor linearity and proportionality. In the next section, these conditions are examined using the household panel data.

4. Empirical Analyses

4.1 Data

To test and estimate the collective model, several features are required in the data. First, information on household demands is needed; thus household data has to be used. Also enough price variation is necessary for allowing us to estimate the price responses reliably. This already rules out many data sets since this requires either a long time series of cross sections or a shorter time series with some observable cross-section price dispersion within the period. Finally reliable information on the individual incomes of the members of the household is necessary since these incomes will be our prime candidates for distribution factors.

As with the previous papers, the Japanese Panel Survey of Consumers (JPSC) is also used. JPSC is a multi-staged stratified clustered survey that collects information on monthly expenditures, incomes, labor supply, and demographics for individual households. The samples are composed of three different cohorts. Cohort A consists of a group of young women aged between 24 and 34 who were randomly selected from across Japan in 1993 for an in-home questionnaire survey. Cohort B, consisting of women aged between 24 and 27 in 1997, and cohort C, consisting of women aged between 24 and 29 in 2003, were added respectively in 1997 and 2003. The relatively high response rate of this annual survey has overcome the inherent disadvantages

of a panel survey. JPSC contains household data and information on household demands for consumption goods. The consumption data includes enough number of durable goods and it enables us to estimate the price responses. In addition, the incomes of each member of the sample families were reported and this data could be distribution factors. Therefore, JPSC meets the necessary conditions to test and estimate the collective model. Although the survey started in 1993, the data did not have consumption data by item at the early stage. This information started to be available in 1998, so the observations only after 1998 were used here.

Prices were taken from the retail price survey conducted by the Japan statistics bureau. The survey covers most major consumption goods and gathers data from towns of different sizes all over Japan every year. The bureau sometimes change the items included in the survey following any changes in the life styles among the people. In our analyses, the prices of goods which represent each category and are consistently recorded were chosen.

4.2 Sample Selection

Table 3.1 gives the sample selection path followed; the principal selection is on all agents being in full-time employment and under the age of 65. In addition, we selected on the education level being observed, net household income being positive, and, for couples, gross earnings being above JPY 100,000 (in 1998 terms) (see "reasonable earnings" in the Table). Experiments were also made with cleaner samples than those reported. For example, households with very low net incomes or high budget shares for individual goods were excluded. In no case were the qualitative results

different. For single-person households, most samples were kept, but for two-person households, many samples dropped through the selection process. This means that females earned a certain amount of income by themselves when they were single and lived alone. However, once they got married, many wives did not work or earned little. Thus, only 519 samples were selected among 898 married samples.

Table 3.2 presents sample means and other statistics for all of the variables used in the analysis except for the homogeneous prices. The mean of monthly earnings of two-person households was larger than the one of single-person households, but wives of two-person households had lower incomes than single females. On the other hand, husbands earned more than single women. The standard deviations of the household expenditure and net income for couples were larger than those for singles. This indicates that there were more variety in life styles among married couples than among singles in terms of income and expenditure.

Regarding comparison of expenditure share by items (Table 3.3), both single-person and two-person households spent a large portion of their incomes on food. In this survey, food includes both eating at home and eating outside, and the service fees at the restaurants were also included. Single-person households spent more money on clothing than two-person households. This may suggest that the preferences between the two kinds of households were different. On the other hand, two-person households used slightly more money on transportation than single-person households. Neither of them purchased very much clothing, and a few households ever bought no clothing. There did not seem to be much difference in consumption on communication between single-person and two-person households.

4.3 Single-person Households

Figure 3.1 shows the average income of selected single-person households by age in 1998, 2001, and 2005. This figure indicates that the average income did not change so much as the people got older. This can be attributed to the jobs which female workers were involved in. Traditionally, more than 50 percent of female labor are non-regular workers and the wage of non-regular workers increase little even for older workers (Steinberg and Nakane, 2010). Figure 3.2 represents consumption of single-person households by age. Food occupied a large portion of their expenditure on nondurable goods for every one and consumption of clothing was large for some cohorts. Utility and communication costs seemed stable across ages and years.

4.4 Two-person Households

As for two-person households, the husbands earned more than wives even though both had their own jobs. The difference in the amount of earnings became larger as they got older. In this case, it was also observed that the wages of female workers did not necessarily increase while male workers earned more as they got older. Regarding the consumption by goods, food occupied a large part of total expenditure for every household across years. Communication and utility costs were stable like single-person households. The expenditure on clothing declined as the samples became older. This might be caused by the changes in the preference. For two-person households, the samples were asked how much money they spent for each household member in one month. According to their answers, the portion of

the consumption for husbands was much larger than the one for wives. Compared with Figure 3.3, the share of consumption spent for wives was unnaturally small. This might be brought about by the fact that the respondees were women. According to Vardharajan (2005), the responses about private consumptions could be different between husbands and wives. In this case, wives might underestimate the benefit which they obtained for themselves. In the analysis of the demand function, the data of expenditure by item was used and that kind of bias was more likely to be avoided.

The survey also collects information on how the households manage their income. They set up sixteen different types of income management, which can be divided into three groups. In A and B, only husbands have monthly earnings. If husbands give only a part of their wages to their wives, the households belong to A. Meanwhile, if husbands give their whole salaries to their wives, then the households belong to B. Our samples for the analysis on the collective model were only composed of households where both members have full-time jobs, so the type A and B households were not included although they are one of the major types in Japan. From C to L, both husbands and wives have monthly earnings. In C, husbands and wives pool their whole wages and the wives manage their incomes. In D, wives manage the whole incomes of their husbands and a part of their own earnings as a common financial resource, but, at the same time, wives keep a part of their own wages for their personal use. In E, wives manage the incomes of their husbands as a common resource, and keep all of their own earnings for their personal use. In F, husbands keep a part of his earnings for their personal use, and wives control the rest of their combined incomes. In G both husbands and wives keep a part of their own wages and wives manage the rest of their

incomes. In H, wives do not pool their own wages and manage a part of the wages of their husbands. Husbands also secure a part of their earnings for their personal use. In type I, husbands and wives manage their own salaries individually. In J, K, and L, husbands control their pooled salaries, and, at the same time, they have a part of their wages for their private expenditure. In J wives let husbands control a part of their wages. In K wives give all of their salary to their husbands, and receive an allowance. Type L is similar to K, but wives do not have money for their personal use.

Those 16 types can be categorized into three different groups. One is a group of households managed by wives such as A-H. Another is a group of households managed by husbands such as J, K, and L, and the other is a group of households where the husbands and wives manage their incomes individually, such as I. The income management type should have an influence on how households spend their income, and the dummy variable which distinguishes the management type was included in the collective model in section 5.

According to Table 3.4, in most households, wives took the initiative to manage their incomes. However, there seemed to be some changes occurring year to year. In 1998, 83.0% of households belonged to the wife-management type, but in 2003, the ratio had dropped to 73.2%. On the other hand, households categorized into the other two types had increased. In 1998, husband-management households and individual management were 6.8% and 5.1% respectively. In 2003, the ratios rose to 10.5% and 14.0%. Because most households stayed in the same category (Table 3.A.6), this change was caused by joining of new samples. This means that there is a difference in the type of income management at home among cohorts (Table 3.6).

The relationship between income and management type was analyzed. Table 3.7 and 3.8 show that the management type was not strongly correlated with income level. In addition, the relationship between the management type and other variables except consumption such as education level of household head or home ownership were checked and it was found that the management type did not have any strong correlation with other variables. The relationship between the consumption and the management type is analyzed in the following section.

Last but not least, the demographic variables of single-person and two-person households were analyzed. There existed significant difference in car-ownership and house-ownership between the two kinds of households. On the other hand, there was no significant difference in residence, education level, white collar dummy, education level and age.

Table 3.1 Sample Selection

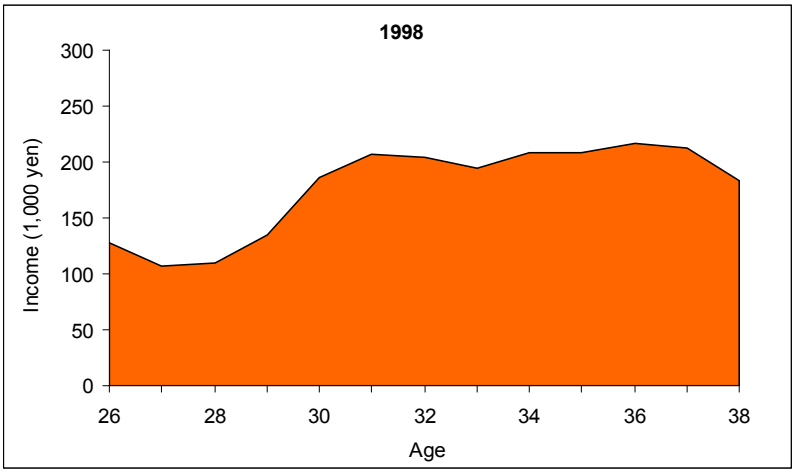
	Single Women	Couples
Full Sample	725	898
Employment	725	876
Age<65	725	876
Income positive	725	525
Education level given	725	525
Reasonable expenditure	723	521
Reasonable earnings	723	519

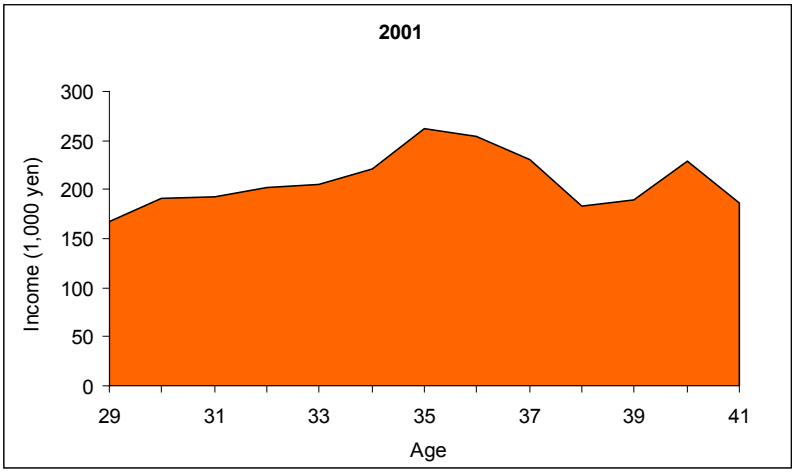
Table 3.2 Description of Monthly Total Expenditure and Earnings

	Single		Couples	
	Mean	S.D.	Mean	S.D.
Total Expenditure	165.668	68.239	234.418	102.604
Household Net Income	212.996	88.219	370.382	148.458
Husbands' Earnings	-	-	261.044	93.972
Wife's Earnings	-	-	141.443	79.982

Table 3.3 Description of Budget Shares

Budget Shares	Single		Couples	
	Mean	# of Zeros	Mean	# of Zeros
Food	0.445	7	0.468	4
Utilities	0.150	38	0.162	2
Men's Clothing	0.000	723	0.014	245
Women's Clothing	0.139	263	0.011	264
Transportation	0.132	118	0.171	44
Communication	0.134	66	0.118	39





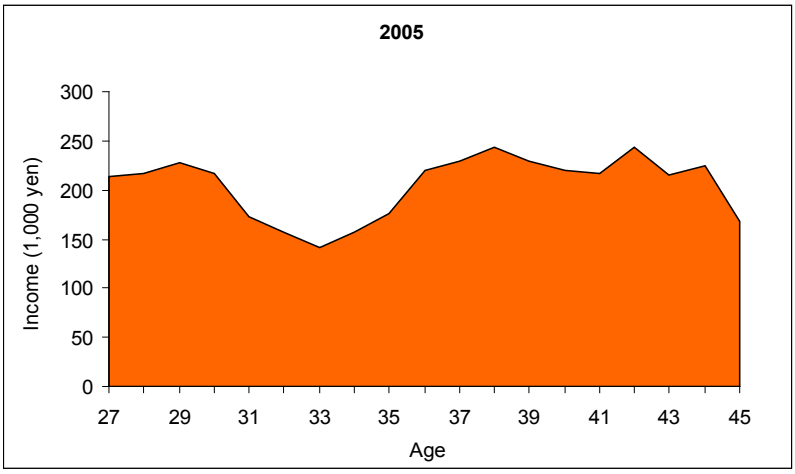


Figure 3.1 Monthly Income of Single-person Households

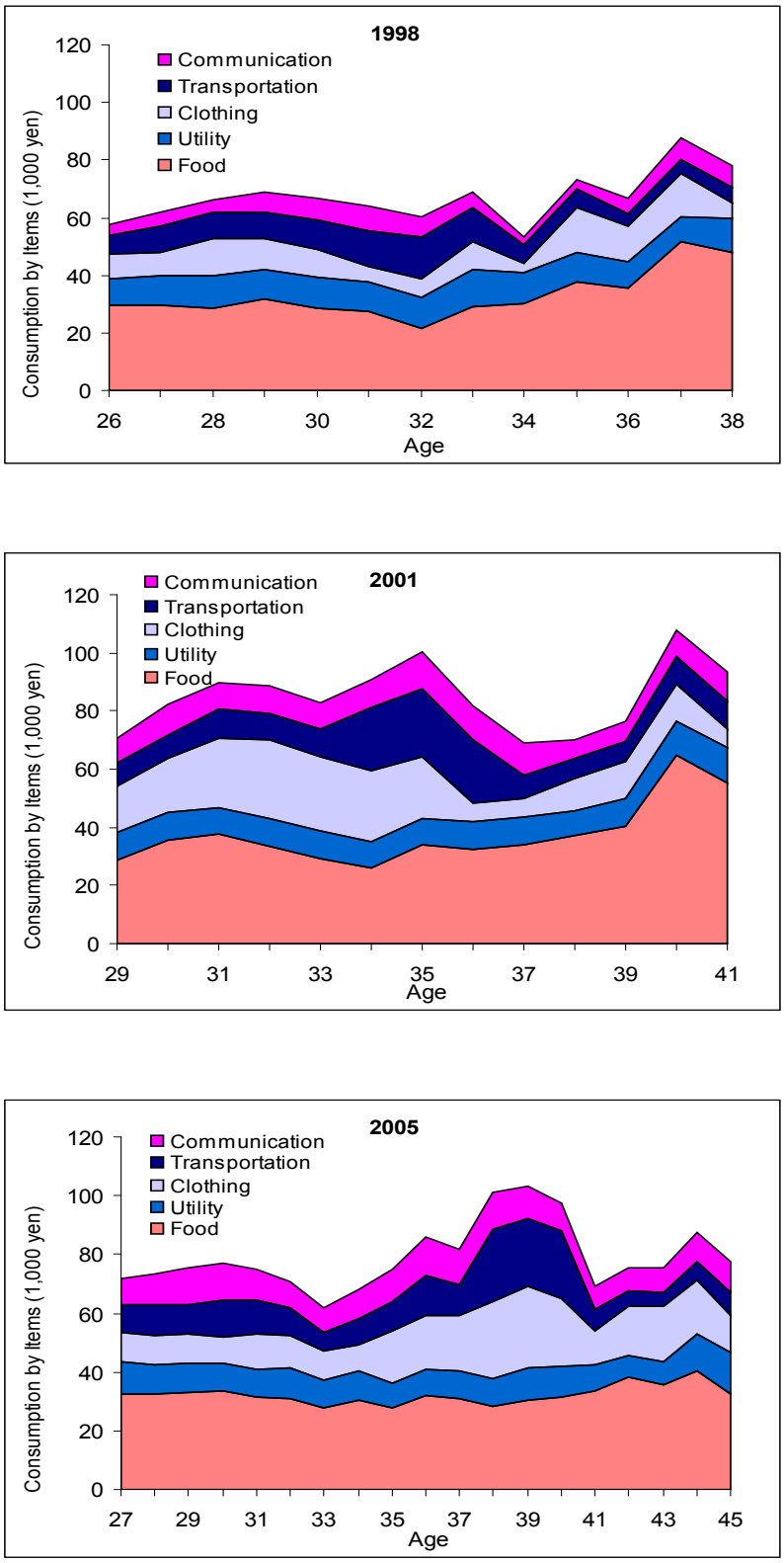
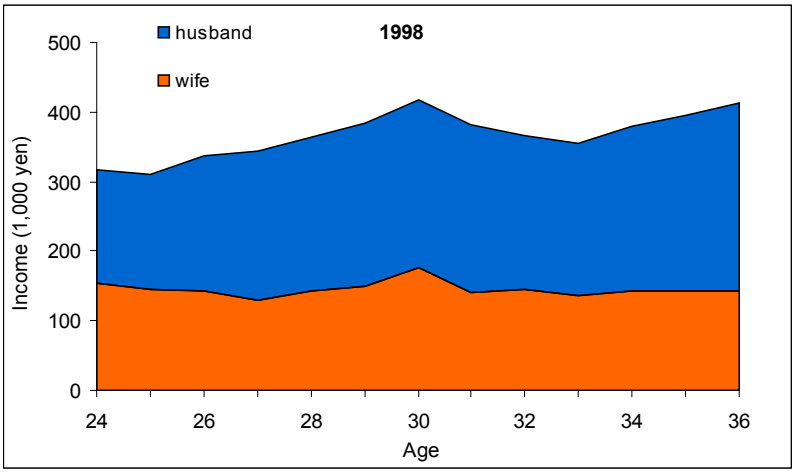
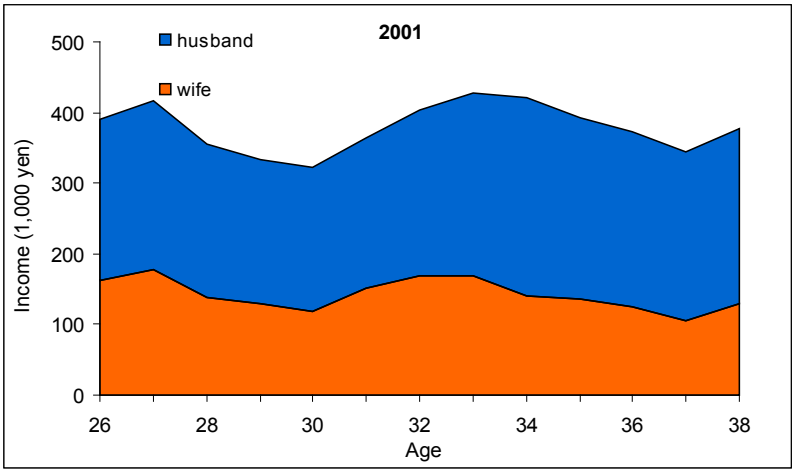


Figure 3.2 Monthly Consumption of Single-person Households by Item





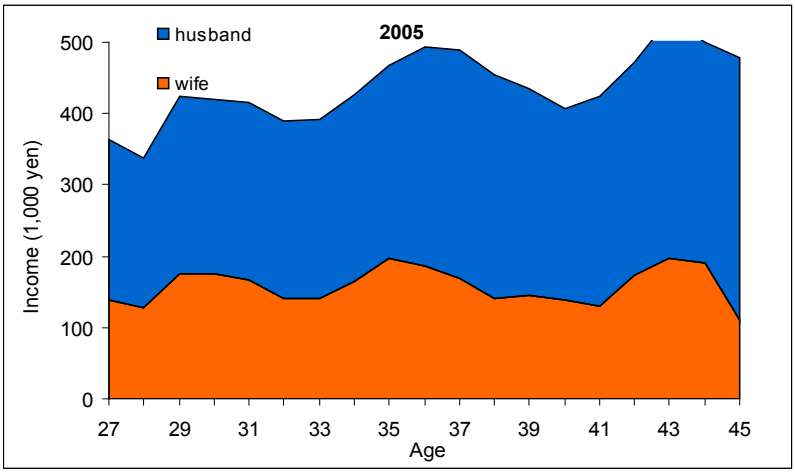


Figure 3.3 Monthly Income of Two-person Households

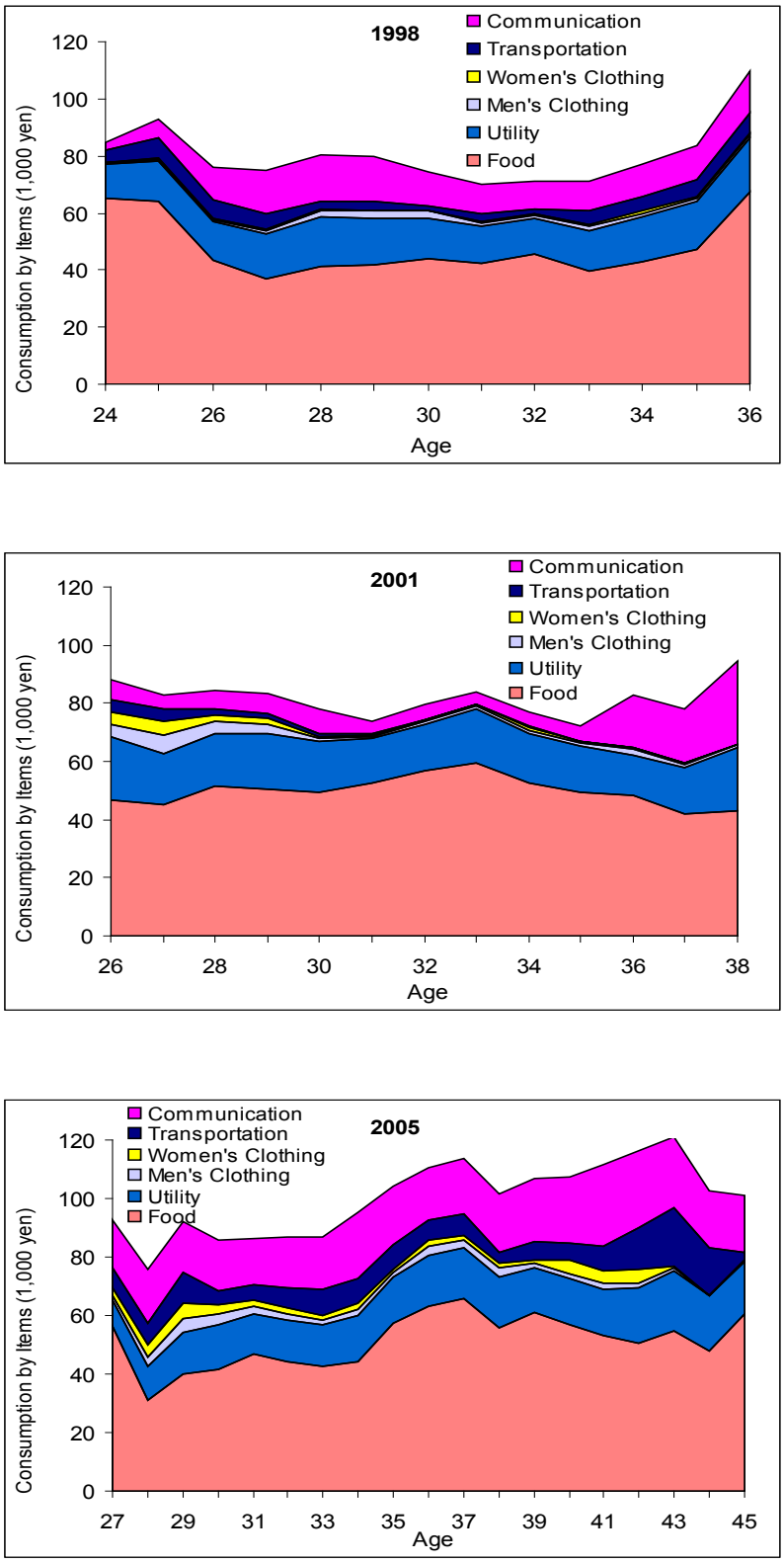
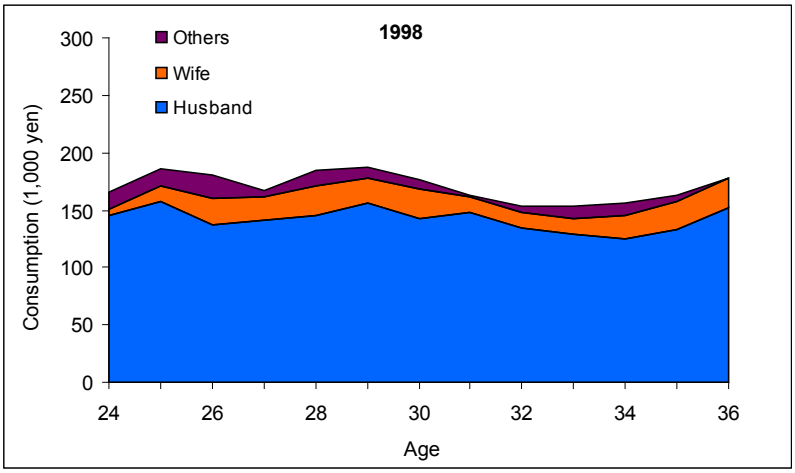
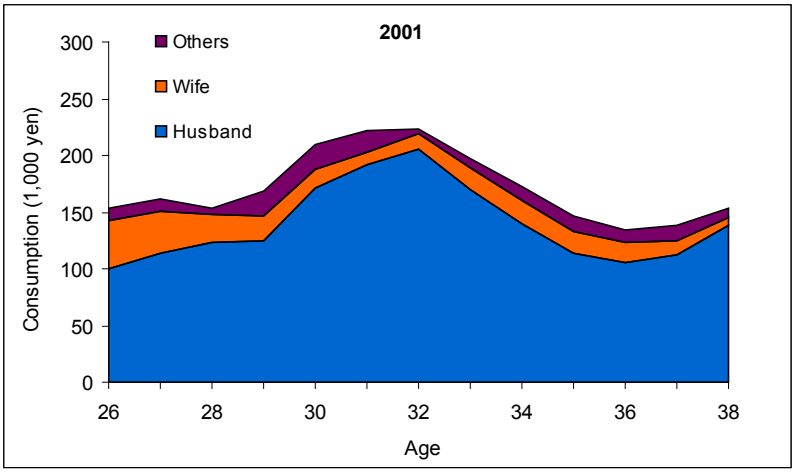


Figure 3.4 Monthly Consumption of Two-person Households by Item





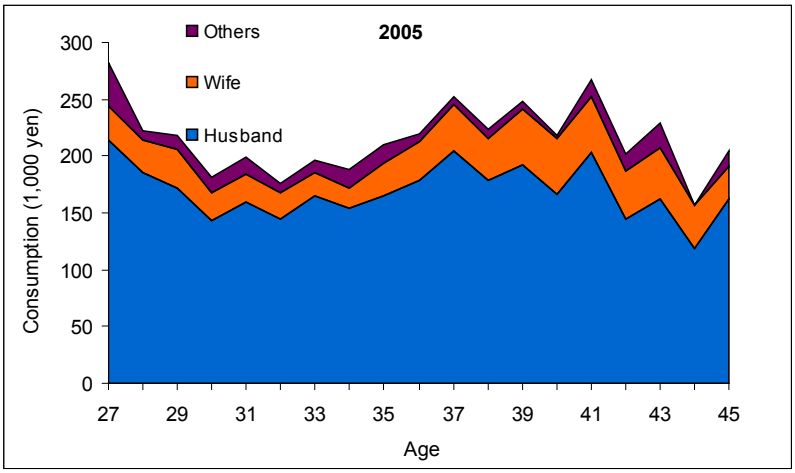
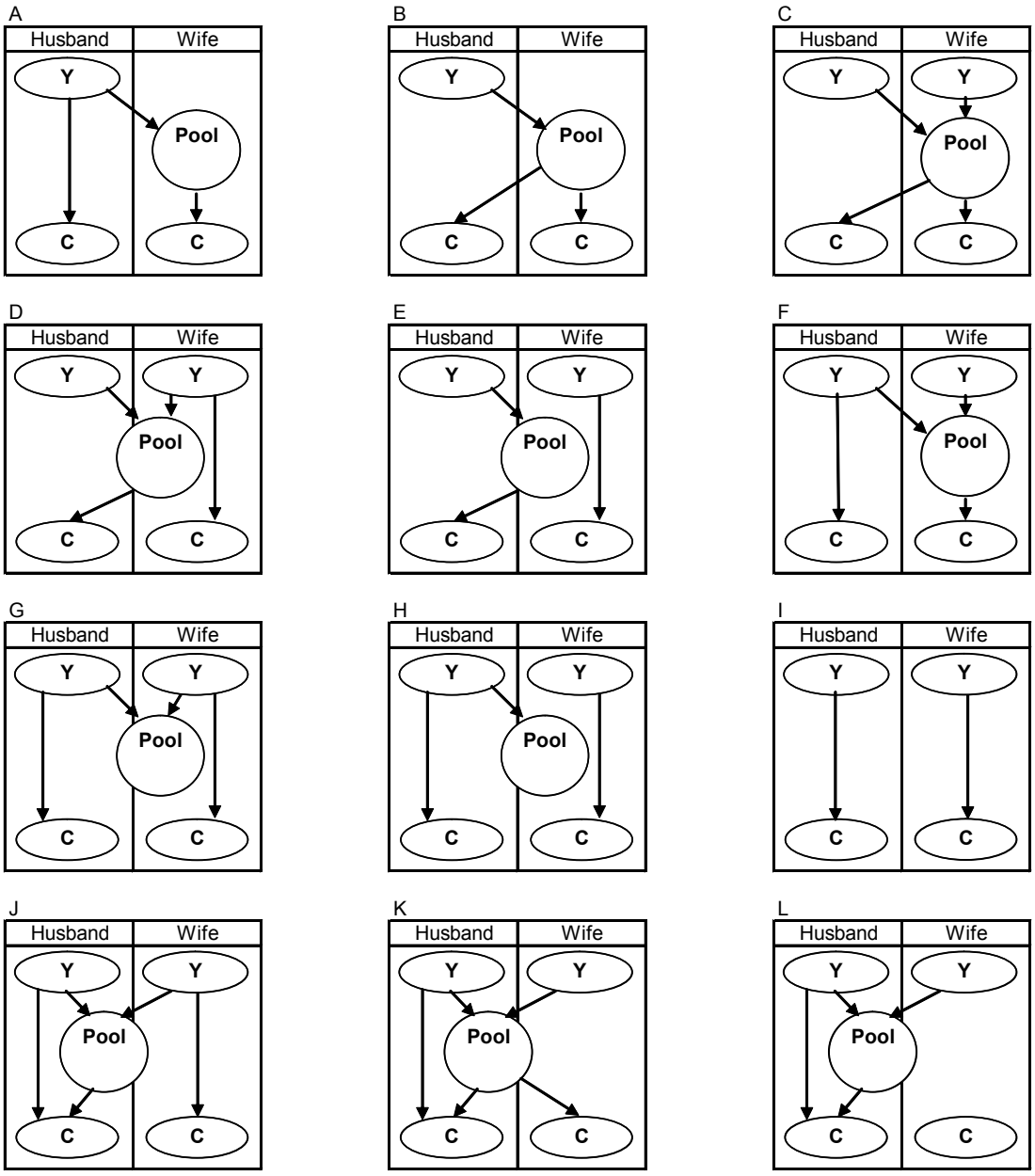


Figure 3.5 Monthly Consumption of Two-person Households by person



Y: Income
C: Consumption

Figure 3.6 Income Management Type

Table 3.4 Distribution of Income Management Type

Type	1998 (%)	2001 (%)	2005 (%)
A	0.00	0.00	0.00
B	0.00	0.00	0.00
C	38.98	48.15	30.23
D	1.69	7.41	2.33
E	18.64	11.11	12.79
F	11.86	11.11	3.49
G	5.08	5.56	9.3
H	6.78	3.7	15.12
I	5.08	7.41	13.95
J	5.08	3.7	5.81
K	0.00	0.00	4.65
L	1.69	0.00	0.00
Others	5.08	1.85	2.33
Total	100	100	100

Table 3.5 Distribution of Income Management Type by Year

Type	1998 (%)	2001 (%)	2005 (%)
Wife Management (A-H)	83.03	87.04	73.26
Husband Management (J-L)	6.77	3.70	10.46
Individual Management (I)	5.08	7.41	13.95

Table 3.6 Distribution of Income Management Type by Cohort

Type	Cohort A (%)	Cohort B (%)	Cohort C (%)
Wife Management (A-H)	85.52	83.15	70.94
Husband Management (J-L)	4.98	11.80	13.68
Individual Management (I)	8.60	3.37	15.38

Table 3.7 Monthly Income of Two-person Households by Management Type and Year

1998

Type	Median	S.D.	Min	Max
Wife Management (A-H)	314.6	112.9	87.1	687.3
Husband Management (J-L)	300.1	97.6	232.3	435.6
Individual Management (I)	319.5	148.4	300.1	566.3

Table 3.7 (Continued)

2001

Type	Median	S.D.	Min	Max
Wife Management (A-H)	346.8	138.0	192.1	809.9
Husband Management (J-L)	255.2	96.1	187.2	323.2
Individual Management (I)	396.6	168.7	78.8	443.3

2005

Type	Median	S.D.	Min	Max
Wife Management (A-H)	350.0	129.1	120.0	763.0
Husband Management (J-L)	380.0	250.0	145.0	911.0
Individual Management (I)	319.5	206.0	130.0	920.0

Table 3.8 Monthly Income of Two-person Households by Management Type and Cohort

Cohort A

Management Type	Mean	S.D.	Min	Max
Wife Management (A-H)	385.9	156.9	87.1	1093.7
Husband Management (J-L)	577.4	352.1	169.0	1165.0
Individual Management (I)	423.1	181.6	78.8	964.2

Cohort B

Management Type	Mean	S.D.	Min	Max
Wife Management (A-H)	359.6	111.8	156.6	757.0
Husband Management (J-L)	344.9	130.0	185.9	730.0
Individual Management (I)	324.2	79.2	270.0	478.6

Cohort C

Management Type	Mean	S.D.	Min	Max
Wife Management (A-H)	337.2	127.0	119.6	763.0
Husband Management (J-L)	316.3	74.1	145.0	427.0
Individual Management (I)	374.0	184.2	130.0	920.0

Table 3.9 Means of Demographic Variables

Variables	Single Women	Couples
City dweller	0.451	0.412
Car owner	0.394	0.890
Homeowner	0.107	0.331
Higher Education	0.494	0.447
White collar	0.668	0.611
Age	31.018	34.233
Age of Wife	-	32.039
Wife Management	-	0.809

5. Analyses and Interpretation

5.1 Econometric Condition

Unobservable heterogeneity should be allowed in each partner's preferences and the distribution function. In addition, the possible endogeneity of total expenditure is allowed. In a previous sector, it is mentioned that equation (5) is nonlinear. First the parameters and covariance matrix of the parameters of the system (5) with no restrictions are estimated by using MLE methods. These are denoted by φ and C respectively. Then the restrictions are imposed by solving

$$\min_{\eta}(\varphi - f(\eta))' C^{-1} (\varphi - f(\eta)) \tag{6}$$

where $f(\eta)$ is the mapping from the restricted parameters η to the unrestricted parameter φ. The value of this minimand gives the χ^2 statistic for the restriction. The covariance matrix for the restricted parameter estimates are given by $(F'CF)^{-1}$ where F is the Jacobian of $f(\cdot)$ evaluated at $\hat{\eta}$, the vector that minimizes (6).

5.2 Unitary Model

First it was assumed that the unitary model holds for all households. The parameters of the system given in (5) without the Θ matrix were estimated. Prices included food prices, which were numeraire, utility prices, clothing prices, transportation fees, and communication prices. For the single-person households, there were seven preference variables in the $a(\cdot)$ index. These were dummies for car ownership, house ownership, living in a city, the female having more than high school education, the female having a white collar job, age and age squared. Also, two variables were included in $b(\cdot)$ index; car ownership and house ownership. The absolute price of the numeraire good was excluded from the demand system since homogeneity was maintained and it was also correlated with total expenditure since agents were not at all sensitive to real interest rates. As to the income variables, in a unitary model income should not affect demand once we condition on total expenditure but it was obviously correlated with total expenditure. One objection to this is that preferences may be correlated with demand if, for example, higher paid jobs require more expensive clothing. In this case we would expect to see that higher paid individuals had a higher budget share for clothing than lower paid individuals with the same total expenditure. This was entirely plausible, but it was rejected in our case.

For couples, in addition to the five goods prices, the prices of men's clothing were introduced. Eight preference factors were included in the $a(\cdot)$ index. Six dummy variables and three continuous variables were also added. The selection of these variables was based on the end result of some preliminary analysis which excluded some other variables (such as the wife's education) which were found to be wholly insignificant. The dummies were

home ownership, living in a city, car ownership, the husband having more than a high school education, the husband having a white collar job, and the wife-management dummy. The wife-management dummy variable took the value one if the income management types were categorized into A-H. Otherwise, the variable took zero. The three continuous variables were the age and age squared of the husband and the age of wife. For the preference factors in the b( ) index, the same variables were included as for singles, that is, dummy variables for car and home ownership.

Table 3.10 and Table 3.11 show the estimated parameters of single-person households and two-person households respectively. Among single-person households, city-dweller spent more on transportation and communication. In general, in cities, people commute by public transportation every day and have more chances to use communication devices, so the signs of the parameters make sense. Home owners spent less on transportation and communication. This might be because their houses were built near their offices and the commute fees could be reduced. Although the reason for lower expenditure on communication is hard to define, it might be that home owners took advantage of obtaining special discount when making contract with communication companies such as a combined telephone, TV, internet package. The expenditure on transportation and communication of higher educated people and white collars was also lower. Maybe they could afford to have or rent houses near their offices to save on transportation and communication fees. In the case of two-person households, city-dwellers spent more on utilities, whose charges are higher in the city areas. Household owners also spent more money for utilities. In general, privately owned houses are larger than rented houses, so they need more utilities. What is interesting

is that higher educated people or white collars spent more money on their clothing. This might represent that higher educated people or white collars were required to wear a variety of clothes or higher quality clothing. Wife-management dummy represents that the households where wives managed their incomes saved more on the expenditure on utilities. On the other hand, those households purchased more clothes for both men and women. According to this model, wives might know more about how to reduce the utility cost. Instead, they tended to spend more on their personal items.

In Table 3.13, the tests for symmetry for our two strata are presented. It seems that the singles data were consistent with the unitary model (or at least the implications of symmetry and the exclusion of income). The results for couples are representative of the results usually presented in the literature on demand analysis on micro data: the symmetry restrictions were rejected at conventional sizes. One reaction to this is to adjust significance levels so that these test statistics are not interpreted as indicating rejection. For example, if a Schwarz critical level of (degrees of freedom * log (sample size)) for both of the tests given here are used, then it would be concluded that the unitary model was, a posteriori, the more likely. Under this interpretation there are no problems with the application of the unitary model to household data. The converse view is that the restrictions are suspect and that we cannot necessarily apply the unitary model to two-person households. Now testing the implications of our proposed alternative for couples, the collective model is investigated.

5.3 The Collective Model

The results presented in Table 3.13 suggest that there were some problems with imposing the unitary model on the couple data that did not appear for single-person households. Thus, the collective model for couples was estimated. To do this, two extra variables on the right-hand side of the demand equations were included: First, the log of the wife's earnings minus the log of the husband's income, which is called the income difference; Second, the wife's gross income. The parameter estimates for the unrestricted demand system are presented in Table 3.12; the tests of particular interest are presented in Table 3.14. In the collective model, higher educated households and white collar workers tended to spend more on their clothing. The main difference in estimated parameters between the collective model and the unitary model was the wife-management dummy. This time, the expense of wife-management households was higher, but the consumption on transportation and communication occupied a smaller portion. This can be that according to this model, the households whose income was managed by wives spent more on home operations.

The first two rows in Table 3.14 test for symmetry and symmetry plus rank one. Comparing the test statistics for symmetry in Tables 3.13 and 3.14 it can be seen that adding the individual income variables decreases the test statistic slightly but not to the point where symmetry at conventional levels of significance would not be rejected. The SR1 condition, however, was not rejected. Thus the price responses were consistent with the collective model. The next row presents the test for distribution factor proportionality. As already discussed this restriction is independent of the test for SR1. The proportionality test was also not rejected. Finally, a test for SR1, distribution

factor proportionality, and distribution factor linearity was conducted together; see the final row of Table 3.14. As can be seen, these restrictions were not rejected. It can be concluded that the data were consistent with the collective setting

Although the foregoing analysis indicates that it is necessary to weaken the unitary model for two-person households, it is not so clear that this has any strong implications on the values that we are usually concerned with in demand models. In this investigation, one further restriction on our estimates of the collective model was imposed. This restriction was that it is only the difference in log earnings that enters the sharing function. This is a very natural assumption to test for in this context. The $\chi^2(5)$ value with the proportionality factor in the collective-restricted model (the last row of Table 3.14) as zero was 240.65; thus the hypothesis that the wife's income has a role to play over and above its effect on the differences in log incomes can be rejected. In all that follows the unrestricted unitary model was compared with the unrestricted collective model with two proportional factors (Table 3.14) and the restricted collective model with only the difference in log income (Table 3.15). Referring to Table 3.15, it seems that an increase in the wife's share of income (holding everything else constant) increased the demand for men's and women's clothing and decreased the demand for utilities.

In order to analyze the robustness of the collective model of two-person household and the possible patterns of the consumption behavior of three-person households which consist of husband, wife and one child, the same regression model and tests for as the two-person households were conducted using three-person household data. First, it was confirmed whether the unitary model can be applied to three-person households. Then, it was examined

whether the collective model of two-person households can explain how members allocate their incomes in three-person households. Those results were shown in Table 3.16-3.20.

Table 3.18 shows that it might not be appropriate that the unitary model is applied to three-person households since the symmetry was rejected. Then, the test of SR1, distribution factor proportionality, and SR1, distribution factor proportionality and linearity was conducted. According to Table 3.19, it cannot be rejected that the collective model of two-person households represents the intra-household income allocation of three-person households. This can be interpreted in a couple of different ways. First, the consumption behavior of three-person households can be explained by two utility functions. Maybe husbands and wives decide how to spend their incomes, or the utility function of their children is the same as either husbands' or wives'. Second, the variables should be changed from two-person households to three-person households. In this dataset, the available variables were limited but maybe different variables could be inserted into the model to check whether the collective model can be adopted to three-person households. Third, the collective model of two-person households is not robust enough. Although the hypothesis that the empirical data does not support the collective model of two-person cannot be rejected, that model might not grasp the intra-household income allocation of two-person household accurately. This is why the collective model did not distinguish between two-person households and three person households.

Table 3.10 Parameter Estimates for Unitary Model of Single Households

	Utility	Women's clothing	Transportation	Communication
Intercept	-0.975	0.376	1.814	0.152
	[0.426]	[0.717]	[0.968]	[0.854]
City	-0.00985	0.0308	0.131	0.0710
	[0.0161]	[0.0299]	[0.0434]	[0.0308]
Car Ownership	-0.0320	0.0835	0.0334	0.0370
	[0.0323]	[0.0739]	[0.0564]	[0.0558]
Home Ownership	0.654	0.186	-1.214	-1.218
	[0.330]	[0.450]	[0.729]	[0.658]
Higher Education	-0.00275	0.0140	-0.0761	-0.0422
	[0.00874]	[0.0156]	[0.0242]	[0.0168]
White Collar	-0.00796	0.0132	-0.0605	-0.0249
	[0.00754]	[0.0144]	[0.0224]	[0.0147]
Age	-0.000607	0.0148	0.0421	0.0164
	[0.00595]	[0.0133]	[0.0215]	[0.0126]
Squared Age	4.69e-06	-0.000243	-0.000707	-0.000271
	[9.33e-05]	[0.000204]	[0.000326]	[0.000194]
Price (U)	0.263	-0.694	-0.183	0.241
	[0.266]	[0.357]	[0.577]	[0.390]
Price (W)	-0.0216	0.0827	0.0105	0.0168
	[0.0229]	[0.0526]	[0.0413]	[0.0407]
Price (T)	0.398	0.161	-1.218	-0.882
	[0.202]	[0.314]	[0.461]	[0.389]
Price (C)	0.235	-0.240	-0.782	-0.102
	[0.216]	[0.157]	[0.343]	[0.283]
Beta Intercept	-0.323	0.491	0.864	0.344
	[0.297]	[0.292]	[0.448]	[0.481]
Beta Car Owner	-0.292	0.497	3.542	1.380
	[0.565]	[0.526]	[0.704]	[0.951]
Beta Home Owner	-0.00585	-0.207	1.051	0.684
	[0.335]	[0.236]	[0.553]	[0.438]
Lambda	1.002	-1.299	-4.236	-0.840
	[0.468]	[0.399]	[0]	[0.736]
Observation	723			

Table 3.11 Parameter Estimates for Unitary Model of Two-person Households

	Utility	Men Clothes	Women Clothes	Transportation	Communication
Intercept	-0.0320	0.0291	-0.0253	-0.0989	0.515
	[0.939]	[0.448]	[0.415]	[1.007]	[0.885]
City	0.169	-0.112	-0.103	-0.0880	-0.00636
	[0.0667]	[0.0495]	[0.0417]	[0.0675]	[0.0817]
Car	0.569	-0.377	-0.337	-0.0153	-0.122
Ownership	[0.175]	[0.109]	[0.0916]	[0.190]	[0.208]
Home	1.169	0.372	0.0987	-0.830	-0.947
Ownership	[0.460]	[0.213]	[0.151]	[0.341]	[0.447]
Higher	-0.128	0.0853	0.0748	0.0400	0.00943
Education	[0.0547]	[0.0352]	[0.0298]	[0.0484]	[0.0570]
White Collar	-0.126	0.0885	0.0814	0.0640	-0.00101
	[0.0604]	[0.0380]	[0.0334]	[0.0511]	[0.0617]
Age	-0.0206	0.0143	0.0139	0.0154	0.00118
	[0.0289]	[0.0197]	[0.0176]	[0.0183]	[0.0114]
Squared Age	0.000342	-0.000226	-0.000216	-0.000247	-4.28e-05
	[0.000401]	[0.000272]	[0.000243]	[0.000256]	[0.000176]
Wives' Age	-0.00341	0.00141	0.00108	-0.00193	-8.91e-05
Management	[0.00579]	[0.00394]	[0.00353]	[0.00362]	[0.00190]
Wife	-0.168	0.114	0.101	0.0964	0.0156
	[0.0668]	[0.0438]	[0.0370]	[0.0628]	[0.0796]
Price (U)	0.392	-0.0167	-0.0731	-0.335	-0.359
	[0.0726]	[0.0723]	[0.0514]	[0.122]	[0.175]
Price (M)	0.0282	-0.0206	-0.0167	0.0260	-0.00726
	[0.0123]	[0.0101]	[0.00809]	[0.0180]	[0.0141]
Price (W)	-0.0293	0.169	0.122	-0.0112	-0.115
	[0.0345]	[0.0555]	[0.0381]	[0.0532]	[0.0708]
Price (T)	0.958	-0.535	-0.564	-0.649	0.220
	[0.500]	[0.765]	[0.270]	[0.580]	[1.179]
Price (C)	-0.200	0.552	0.348	-0.00313	-0.711
	[0.251]	[0.402]	[0.178]	[0.326]	[0.626]
Beta	-0.262	0.368	0.324	0.114	-0.461
Intercept	[0.229]	[0.360]	[0.166]	[0.292]	[0.559]
Beta Car	-0.464	0.859	0.245	0.222	-0.627
Owner	[0.544]	[0.748]	[0.284]	[0.448]	[1.039]
Beta Home	-0.936	-0.224	-0.0883	0.894	1.226
Owner	[0.507]	[0.413]	[0.245]	[0.336]	[0.565]
Lambda	-0.00598	0.0470	0.0327	-0.00992	-0.0530
	[0.0118]	[0.0237]	[0.0163]	[0.0128]	[0.0312]
Observation	519				

Table 3.12 Parameter Estimates for Unrestricted Collective Model of Two-person Households

	Utility	Men Clothes	Women Clothes	Transportation	Communication
Intercept	-5.21e-07	-1.41e-08	9.52e-08	1.01e-06	-1.28e-07
	[1.18e-07]	[2.00e-08]	[3.08e-08]	[2.50e-07]	[6.80e-08]
City	0.528	0.0948	-0.0255	-0.476	-0.169
	[0.0618]	[0.117]	[0.0464]	[0.0529]	[0.0885]
Car	0.0353	0.0454	0.0632	-0.0110	-0.0645
Ownership	[0.0603]	[0.0988]	[0.0219]	[0.0434]	[0.123]
Home	0.0852	-0.0377	0.149	-0.0340	-0.129
Ownership	[0.0565]	[0.110]	[0.0415]	[0.0588]	[0.145]
Higher	0.333	0.780	0.915	-0.689	-1.904
Education	[0.0644]	[0]	[0.153]	[0.142]	[0]
White Collar	-0.00781	0.0823	0.155	-0.0128	-0.139
	[0.0615]	[0.131]	[0.0759]	[0.0641]	[0]
Age	0.00137	-0.00759	0.000477	0.0342	-0.00233
	[0.00881]	[0.00376]	[0.00368]	[0.0165]	[0.0115]
Squared Age	0.00469	0.00640	0.00239	-0.0561	-0.00115
	[0.00913]	[0.00405]	[0.00396]	[0.0176]	[0.0123]
Wives' Age	-0.919	0.178	-0.750	-4.320	-0.588
	[0]	[0]	[0]	[0]	[0]
Wife	0.807	-0.477	-0.0483	-0.412	-1.771
Management	[0]	[0]	[0.166]	[0]	[0]
Difference in	-3.655	-0.629	0.678	7.305	0.552
Log earnings	[0]	[0]	[0]	[0]	[0]
Wife's	-1.806	-0.0689	-0.0894	0.916	0.254
Income	[0.106]	[0.209]	[0.142]	[0]	[0]
Price (U)	0.00210	0.00121	-0.00456	-0.0429	-0.0114
	[0.00641]	[0.00458]	[0.00518]	[0.0180]	[0.00998]
Price (M)	0.0265	-0.00783	-0.00537	0.0253	-0.0264
	[0.00896]	[0.00464]	[0.00622]	[0.0239]	[0.0146]
Price (W)	-0.000672	-0.00632	0.00271	0.0213	0.0137
	[0.00738]	[0.00409]	[0.00563]	[0.0265]	[0.0154]
Price (T)	-0.000706	-0.000832	-0.00555	-0.0399	-0.00849
	[0.00436]	[0.00253]	[0.00313]	[0.0139]	[0.00751]
Price (C)	0.00219	0.000682	0.00523	0.00776	-0.00528
	[0.00434]	[0.00252]	[0.00319]	[0.0147]	[0.00761]
Beta	0.00408	-0.00178	-0.00176	0.00265	-0.00334
Intercept	[0.00295]	[0.00175]	[0.00206]	[0.00889]	[0.00504]
Beta Car	-4.01e-05	2.20e-05	2.26e-05	-7.59e-05	1.11e-05
Owner	[3.94e-05]	[2.39e-05]	[2.75e-05]	[0.000119]	[6.71e-05]
Beta Home	-0.000609	-0.000360	0.000210	0.00348	0.00171
Owner	[0.000612]	[0.000354]	[0.000488]	[0.00199]	[0.00106]
Lambda	0.00390	-0.00485	-0.00821	-0.0324	-0.00939
	[0.00510]	[0.00291]	[0.00377]	[0.0161]	[0.00883]
Observation	519				

Table 3.13 Test of the Unitary Model Restrictions

	Single Females	Couples
Symmetry	6.18 (6) [40.3%]	38.01 (10) [0%]
Observation	723	519

Table 3.14 Test for the Collective Model Restrictions

Test for:	
Symmetry	16.62 (10) [8.32%]
SR1	2.79 (3) [42.5%]
Distribution factor proportionality	5.12 (3) [16.4%]
SR1, distribution factor proportionality and linearity	2.14 (4) [71.0%]

Table 3.15 Parameter Estimates for Restricted Collective Model of Two-person Households

	Utility	Men Clothes	Women Clothes	Transportation	Communication
Intercept	4.877	0.436	0.210	0.515	-4.767
	[0]	[0.604]	[0.544]	[1.843]	[1.151]
City	0.595	0.0676	-0.0693	0.978	0.0200
	[0.687]	[0.306]	[0.147]	[0.614]	[0.527]
Car	-0.416	0.163	0.0142	-0.290	-0.227
Ownership	[0.232]	[0.300]	[0.0959]	[0.261]	[0.424]
Home	-0.299	0.0415	0.0216	-0.165	-0.134
Ownership	[0.189]	[0.214]	[0.0649]	[0.205]	[0.296]
Higher	2.283	0.0909	-0.273	2.308	0.436
Education	[0.902]	[1.110]	[0.413]	[0.804]	[1.671]
White Collar	1.372	-0.506	-0.314	1.280	1.552
	[1.150]	[1.692]	[0.533]	[1.317]	[2.279]
Age	0.00315	-0.00199	0.00267	-0.0104	-0.00492
	[0.00461]	[0.00158]	[0.00154]	[0.00838]	[0.00531]
Squared Age	0.843	-0.216	-0.134	2.025	0.709
	[0.294]	[0.151]	[0.132]	[0.476]	[0.607]
Wives' Age	0.00316	-0.0169	-0.0433	-0.279	-0.0461
	[0.0455]	[0.0281]	[0.0269]	[0.126]	[0.0872]
Wife	0.0225	-0.0384	-0.0126	0.0710	-0.00249
Management	[0.0282]	[0.0184]	[0.0160]	[0.0491]	[0.0522]
Difference in	-1.278	0.747	0.664	-2.312	-1.986
Log earnings	[0.720]	[0.407]	[0.349]	[1.550]	[1.437]
Price (U)	-0.0973	-0.0654	-0.0441	0.301	0.411
	[0.0535]	[0.0345]	[0.0295]	[0.0862]	[0.129]
Price (M)	-0.0635	-0.107	-0.119	0.0636	0.357
	[0.0825]	[0.0561]	[0.0521]	[0.104]	[0.174]
Price (W)	0.0506	-0.0335	-0.00475	-0.00372	-0.0932
	[0.0462]	[0.0335]	[0.0262]	[0.0668]	[0.106]
Price (T)	0.00836	0.0113	0.00495	-0.0625	-0.0582
	[0.0150]	[0.0110]	[0.00776]	[0.0425]	[0.0589]
Price (C)	-0.0331	-0.0313	-0.0180	0.116	0.163
	[0.0260]	[0.0177]	[0.0142]	[0.0533]	[0.0763]
Beta	0.0157	0.0117	0.00837	-0.0473	-0.0693
Intercept	[0.0124]	[0.00864]	[0.00662]	[0.0299]	[0.0419]
Beta Car	-0.000238	-0.000183	-0.000124	0.000727	0.00107
Owner	[0.000179]	[0.000124]	[9.74e-05]	[0.000411]	[0.000575]
Beta Home	0.00650	0.00451	0.00245	-0.0256	-0.0308
Owner	[0.00444]	[0.00287]	[0.00238]	[0.00783]	[0.0119]
Lambda	0.0158	0.00608	0.00214	-0.0354	-0.0563
	[0.0166]	[0.0124]	[0.00866]	[0.0494]	[0.0674]
Observation	519				

Table 3.16 Parameter Estimates for Unitary Model of Three-person Households

	Utility	Men Clothes	Women Clothes	Transportation	Communication
Intercept	-4.025	-0.862	-0.339	0.976	6.967
	[0.335]	[0.650]	[0.454]	[1.082]	[0]
City	-0.0163	0.000796	-0.00275	0.0106	0.0252
	[0.0251]	[0.00616]	[0.00381]	[0.0186]	[0.0497]
Car	0.369	0.389	0.213	-0.372	-1.699
Ownership	[0.216]	[0.182]	[0.108]	[0.193]	[0.705]
Home	-0.0413	0.000377	0.000102	0.0456	0.0898
Ownership	[0.0278]	[0.0110]	[0.00730]	[0.0327]	[0.0629]
Higher	0.0135	0.00403	0.00234	-0.0106	-0.0321
Education	[0.0128]	[0.00362]	[0.00229]	[0.00978]	[0.0265]
White Collar	0.0244	0.00443	0.000332	-0.0141	-0.0553
	[0.0129]	[0.00539]	[0.00363]	[0.0109]	[0.0270]
Age	0.0124	0.00355	0.00194	0.000761	-0.0264
	[0.00758]	[0.00261]	[0.00173]	[0.00589]	[0.0156]
Squared Age	-8.01e-05	-3.18e-05	-1.85e-05	-3.24e-05	0.000167
	[8.85e-05]	[2.37e-05]	[1.49e-05]	[6.49e-05]	[0.000182]
Wives' Age	-0.00492	-0.000779	-0.000423	-0.00125	0.00972
	[0.00207]	[0.000995]	[0.000682]	[0.00184]	[0.00431]
Wife	-0.0113	0.00254	-0.00131	-0.00694	0.0161
Management	[0.0152]	[0.00380]	[0.00234]	[0.0115]	[0.0314]
Price (U)	-0.134	-0.458	-0.257	0.393	1.740
	[0.260]	[0.214]	[0.126]	[0.297]	[0.499]
Price (M)	-0.640	-0.0659	-0.0206	0.0886	0.760
	[0.296]	[0.0937]	[0.0604]	[0.144]	[0.390]
Price (W)	-0.0115	0.00134	0.000220	0.0310	0.0238
	[0.0102]	[0.00486]	[0.00362]	[0.0197]	[0.0231]
Price (T)	3.507	0.627	0.358	-1.296	-6.099
	[0.393]	[0.585]	[0.340]	[0.595]	[0.480]
Price (C)	0.734	0.143	0.153	-0.335	-1.545
	[0.429]	[0.256]	[0.127]	[0.218]	[0.887]
Beta Intercept	0.344	0.0845	0.0932	-0.187	-0.799
	[0.315]	[0.138]	[0.0779]	[0.132]	[0.607]
Beta Car	-1.210	-0.591	-0.484	0.944	3.030
Owner	[0.512]	[0.430]	[0.159]	[0.401]	[1.196]
Beta Home	-5.816	-1.245	-0.934	2.759	11.25
Owner	[0.378]	[1.147]	[0.590]	[0.882]	[0]
Lambda	2.517	-0.270	-0.216	-0.121	-1.069
	[0]	[0.309]	[0.201]	[0.504]	[0.834]
Observation	511				

Table 3.17 Parameter Estimates for Unrestricted Collective Model of Three-person Households

	Utility	Men Clothes	Women Clothes	Transportation	Communication
Intercept	1.351	-0.198	-0.266	-0.118	-0.0657
	[0]	[0.326]	[0.221]	[0.470]	[0.755]
City	1.832	1.302	0.569	-1.437	-4.126
	[0.287]	[0.413]	[0.227]	[0.492]	[0.366]
Car	0.831	0.325	0.214	-0.313	-1.603
Ownership	[0.259]	[0.319]	[0.133]	[0.199]	[0.609]
Home	0.400	0.0851	0.0993	-0.0940	-0.667
Ownership	[0.196]	[0.180]	[0.0911]	[0.106]	[0.438]
Higher	-0.807	-0.137	-0.359	0.727	1.118
Education	[0.333]	[0.453]	[0.136]	[0.326]	[0.905]
White Collar	-3.089	-2.095	-1.072	2.004	7.612
	[0.335]	[0.721]	[0.375]	[0.649]	[0]
Age	0.0136	-0.0117	-0.00456	0.00584	0.0241
	[0.00967]	[0.00344]	[0.00253]	[0.0136]	[0.00949]
Squared Age	-0.0298	0.0184	0.0131	-0.00944	-0.0329
	[0.0106]	[0.00377]	[0.00278]	[0.0148]	[0.0104]
Wives' Age	-3.311	-1.712	-0.827	0.837	6.211
	[0.348]	[0.677]	[0.457]	[0.598]	[0]
Wife	-0.348	-0.0230	0.0769	-0.427	0.339
Management	[0.271]	[0.172]	[0.0902]	[0.196]	[0.429]
Difference in	-0.322	-0.0297	-0.0470	0.199	0.498
Log earnings	[0.242]	[0.141]	[0.0861]	[0.143]	[0.386]
Wife's	-1.828	-0.779	-0.408	1.782	1.713
Income	[0.279]	[0.441]	[0.292]	[0.904]	[0]
Price (U)	-0.0474	-0.00988	-0.00542	0.00973	0.0888
	[0.0193]	[0.00783]	[0.00517]	[0.0200]	[0.0328]
Price (M)	0.0201	0.0299	0.0296	-0.0301	-0.0834
	[0.0354]	[0.0484]	[0.0235]	[0.0400]	[0.0976]
Price (W)	-0.00713	0.0358	0.0132	0.0192	-0.0181
	[0.0245]	[0.0351]	[0.0144]	[0.0266]	[0.0737]
Price (T)	-0.000338	0.000657	0.00141	-0.00405	-0.00138
	[0.00817]	[0.00351]	[0.00213]	[0.00771]	[0.0161]
Price (C)	0.0239	0.00704	-0.000745	-0.0148	-0.0514
	[0.00901]	[0.00605]	[0.00375]	[0.00952]	[0.0189]
Beta	0.00441	0.00210	0.00111	0.00380	-0.00809
Intercept	[0.00485]	[0.00209]	[0.00127]	[0.00462]	[0.00945]
Beta Car	-1.75e-05	-2.20e-05	-1.62e-05	-5.39e-05	3.13e-05
Owner	[5.63e-05]	[2.28e-05]	[1.36e-05]	[5.30e-05]	[0.000109]
Beta Home	-0.00164	-0.000230	-3.44e-05	-0.00225	0.00229
Owner	[0.00132]	[0.000661]	[0.000415]	[0.00136]	[0.00261]
Lambda	-0.0107	0.00507	0.00119	-0.00759	0.0116
	[0.0101]	[0.00414]	[0.00249]	[0.00956]	[0.0196]
Observation	511				

Table 3.18 Test of the Unitary Model Restrictions

	Three-person Households
Symmetry	195.71 (10) [0.00%]
Observation	511

Table 3.19 Test for the Collective Model Restrictions

Test for:	
Symmetry	9.17 (10) [51.56%]
SR1	2.12 (3) [54.83%]
Distribution factor Proportionality	3.45 (4) [48.52%]
SR1, distribution factor proportionality and linearity	6.02 (9) [73.77%]

Table 3.20 Parameter Estimates for Restricted Collective Model of Three-person Households

	Utility	Men Clothes	Women Clothes	Transportation	Communication
Intercept	0.873	-0.985	-0.793	0.0924	1.906
	[1.337]	[0.535]	[0.444]	[0.781]	[0]
City	2.727	1.719	0.786	-1.608	-5.837
	[0.453]	[0.438]	[0.254]	[0.570]	[0.488]
Car	1.399	0.738	0.427	-0.526	-2.907
Ownership	[0.304]	[0.453]	[0.204]	[0.256]	[0.797]
Home	0.694	0.331	0.226	-0.213	-1.404
Ownership	[0.226]	[0.253]	[0.148]	[0.124]	[0.565]
Higher	-1.124	-0.547	-0.481	0.896	2.142
Education	[0.423]	[0.471]	[0.145]	[0.358]	[0.994]
White Collar	-5.110	-3.358	-1.730	2.760	11.88
	[0.524]	[0.898]	[0.498]	[0.810]	[0]
Age	-0.0105	0.00313	0.00604	-0.00129	-0.00218
	[0.00465]	[0.00165]	[0.00122]	[0.00650]	[0.00454]
Squared Age	-3.465	-2.184	-1.174	1.107	7.430
	[0.369]	[0.631]	[0.422]	[0.524]	[0]
Wives' Age	-0.413	-0.103	0.0231	-0.223	0.543
	[0.353]	[0.195]	[0.106]	[0.179]	[0.607]
Wife	-0.287	-0.0814	-0.0589	0.218	0.513
Management	[0.210]	[0.124]	[0.0790]	[0.107]	[0.364]
Difference in	-2.327	-0.892	-0.397	1.534	2.672
Log earnings	[0.735]	[0.478]	[0.300]	[1.042]	[1.503]
Price (U)	-0.0486	-0.00878	-0.00503	0.00720	0.0884
	[0.0231]	[0.00839]	[0.00527]	[0.0204]	[0.0432]
Price (M)	0.0580	0.0534	0.0439	-0.0232	-0.173
	[0.0521]	[0.0578]	[0.0291]	[0.0435]	[0.144]
Price (W)	-0.00231	0.0350	0.0180	0.0249	-0.0231
	[0.0314]	[0.0356]	[0.0169]	[0.0266]	[0.0884]
Price (T)	-0.000349	0.00261	0.00274	-0.00590	-0.00350
	[0.00949]	[0.00370]	[0.00219]	[0.00882]	[0.0187]
Price (C)	0.0282	0.00824	-0.000797	-0.0174	-0.0620
	[0.0114]	[0.00781]	[0.00483]	[0.0120]	[0.0242]
Beta	0.00786	0.00380	0.00173	0.00261	-0.0162
Intercept	[0.00567]	[0.00262]	[0.00161]	[0.00552]	[0.0112]
Beta Car	-4.83e-05	-3.73e-05	-2.23e-05	-4.67e-05	0.000101
Owner	[6.59e-05]	[2.57e-05]	[1.53e-05]	[6.12e-05]	[0.000128]
Beta Home	-0.00255	-0.000464	-5.73e-05	-0.00212	0.00421
Owner	[0.00153]	[0.000843]	[0.000535]	[0.00164]	[0.00308]
Lambda	-0.0129	0.00474	0.00135	-0.00588	0.0163
	[0.0116]	[0.00446]	[0.00264]	[0.0109]	[0.0227]
Observation	511				

6. Conclusion

In the above, a general characterization of the collective model was presented. Following Browning and Chiappori (1998), it was shown that the collective model can be completely captured by using a household utility function $u(\cdot)$ that depends on household purchases $\vec{q}$ and a distribution index μ. If the latter is a constant then the usual unitary model can be applied. However, generally the function $\mu(\cdot)$ depends on prices $\vec{p}$, total expenditure x, and distribution factors $\vec{y}$. The fact that all non-preference influences have to act through this index puts stronger restrictions on household consumption behavior. In Sections 2 and 3 these restrictions were explained.

In Sections 4 and 5, the parameters of a demand system were estimated and then some of the predictions of the unitary and collective models were tested. Although minimal assumptions in the theory section were made, stronger assumptions needed to be made in this empirical work. For example, it was assumed that preferences for the nondurables modeled are separable from other goods except for the ownership of a house or car. It was also assumed that the labor supply decision is exogenous to the demand system. Conditional on these reservations the results were unambiguous: the predictions of the unitary model were not rejected for single-person households but they were rejected for two-person households. The predictions of the collective model were not rejected for two-person households. This indicated that the collective setting is worth further investigation.

In Section 4, the characteristics of the data were also discussed. The JPSC included the data of income distribution both by item and membership. This shows the change of household behavior among different generations and at different times. The share of expenditure on essential goods such as

food and utilities seemed stable across generations and years. On the other hand, the expenditure on unessential goods such as clothing or means of communication fluctuated across generations. In general, young households tended to spend more on those unessential goods. This can indicate that the preference might change from generation to generation. Regarding the income allocation among members of households in two-person households, the share of consumption for husbands occupies an extremely large portion of total expenditure. This can be partly due to the bias of respondees. The questionnaires are distributed to females so wives fill out the form in two-person households. According to Vardharajan (2005), the responses between wives and husbands might be different in the consumption for themselves. The underestimation of the expenditure for wives could happen to this survey and the share of the expenditure for their husbands might have been overestimated.

The data set also includes a survey on the types of income management. They categorize the income management into 16 types which can be divided into three groups. One is households where wives managed the household income. Another is those where husbands controlled the income. The final group was husbands and wives who managed the incomes individually. Among all the samples, the households managed by wives occupied most of observations. However, as for those where both husbands and wives have their own jobs, there were some households which belonged to either the husband-management type or the individual management type. In section 5, the wife-management dummy variable was included in the function of the collective model for two-person households.

In Section 5, first it was examined whether the unitary model fits single-person households and two-person households. The results show that it could not be rejected that the consumption behavior of one-person households followed the unitary model. However, the data on two-person households rejected that the unitary model could explain their behavior. Then the analyses about whether the collective model could be applied to two-person households were undertaken. The test for SR1, distribution factor proportionality and linearity indicated that it could not be rejected that the two-person model explained the income allocation of two-person households. The restricted collective model was also estimated and it showed that the total income played an important role in the model.

At the end of Section 5, the data of three-person households was used and it was checked whether the collective model of two-person households could be applied to three-person households. As a result, it could not be rejected that the three-person model could be represented by the two-person collective model. Therefore, it should be necessary to study the collective model for multi-person households further since it might be possible that the model is difficult to extend to the households consisting of more than two members.

APPENDIX

This annex has tables which represent the characteristics of the JPSC. Table 3.A.1 show the income management type of the all samples who were married. Table 3.A.2-3.A.4 show the monthly income by management type of all samples. Then, Table 3.A.5-3.A.7 deal with the monthly allowance and pooled budget in households. Last three tables represent the change of income management type over time. These data has very important information although they were not used in the analyses directly this time.

Table 3.A.1 Distribution of Income Management Type

Type	1998 (%)	2001 (%)	2005 (%)
A	11.78	10.45	10.19
B	37.26	34.01	32.04
C	20.12	22.71	25.30
D	1.41	2.13	2.59
E	6.68	8.53	8.81
F	3.87	4.58	3.20
G	2.37	2.45	2.76
H	2.81	3.09	4.58
I	2.55	2.88	3.02
J	2.64	3.30	2.94
K	1.49	1.07	0.95
L	0.35	0.43	0.69
Others	6.68	4.38	2.94
Total	100	100	100

Table 3.A.2 Monthly Income by Management Type in 1998

	Mean	SD	Min	Max
A	325.15	139.83	64.99	969.99
B	326.77	139.14	72.75	1163.99
C	365.67	132.66	129.01	969.99
D	379.08	131.52	194.00	598.48
E	373.84	147.38	87.30	892.39
F	342.52	117.61	116.40	584.90
G	375.28	202.26	174.60	1242.56
H	366.17	160.01	145.50	793.45
I	384.38	160.74	126.10	708.09
J	363.46	168.84	116.40	899.18
K	335.50	129.22	116.40	523.79
L	341.19	114.82	232.80	444.26
Others	326.22	230.56	15.52	1600.48

Table 3.A.3 Monthly Income by Management Type in 2001

	Mean	SD	Min	Max
A	369.19	196.72	98.72	1665.39
B	335.19	133.58	50.35	991.14
C	406.88	151.21	138.21	1187.59
D	372.91	114.52	216.20	632.79
E	376.58	136.66	167.82	750.27
F	373.69	146.78	127.35	789.75
G	392.73	162.41	162.89	740.39
H	364.51	173.04	138.21	847.01
I	391.92	179.81	78.98	792.72
J	332.87	141.68	92.80	567.64
K	344.43	142.94	138.21	641.67
L	544.93	203.17	325.77	815.42
Others	337.30	180.71	116.49	854.91

Table 3.A.4 Monthly Income by Management Type in 2003

	Mean	SD	Min	Max
A	345.86	154.02	80.16	881.76
B	347.33	153.80	90.18	1252.50
C	417.40	167.25	133.27	1366.73
D	425.12	163.86	170.34	981.96
E	409.52	181.46	110.22	1108.21
F	428.10	173.41	100.20	1002.00
G	400.30	190.37	120.24	945.89
H	407.66	155.22	140.28	829.66
I	375.89	208.07	130.26	1137.27
J	406.19	202.17	145.29	1007.01
K	414.46	100.78	250.50	601.20
L	361.22	192.64	50.10	713.42
Others	262.32	172.98	40.08	796.59

Table 3.A.5 Share of Wives' Allowance and Husbands' Contribution to the Pool to Monthly Income

1998

Share of Allowance

Variable	Obs	Mean	Std. Dev.	Min	Max
A	33	0.09	0.07	0.02	0.35
B	39	0.06	0.05	0.01	0.22
C	61	0.06	0.03	0.00	0.18
F	9	0.09	0.04	0.04	0.15
I	28	0.49	0.43	0.03	1.72
K	17	0.29	0.29	0.01	0.96

Share of Pool

Variable	Obs	Mean	Std. Dev.	Min	Max
A	129	0.55	0.33	0.03	1.95
D (Wife)	15	0.19	0.15	0.04	0.59
F	41	0.46	0.25	0.09	1.03
G	32	0.53	0.29	0.07	1.03
G (Wife)	27	0.22	0.15	0.05	0.72
H	25	0.47	0.22	0.07	0.84
I	28	0.23	0.19	0.00	0.73
I (Wife)	28	0.16	0.15	0.00	0.61

2001

Share of Allowance

Variable	Obs	Mean	Std. Dev.	Min	Max
A	18	0.07	0.08	0.01	0.37
B	44	0.06	0.05	0.00	0.20
C	42	0.07	0.07	0.02	0.36
F	8	0.08	0.05	0.03	0.16
I	31	0.29	0.26	0.04	0.96
K	10	0.17	0.13	0.03	0.37

Share of Pool

Variable	Obs	Mean	Std. Dev.	Min	Max
A	98	0.55	0.31	0.00	1.44
D (Wife)	20	0.18	0.19	0.05	0.93
F	42	0.46	0.25	0.06	1.01
G	28	0.56	0.32	0.14	1.50
G (Wife)	23	0.22	0.13	0.02	0.45
H	23	0.40	0.19	0.07	0.78
I	26	0.21	0.17	0.00	0.72
I (Wife)	25	0.22	0.23	0.00	1.01

2003

Share of Allowance

Variable	Obs	Mean	Std. Dev.	Min	Max
A	27	0.05	0.04	0.01	0.20
B	48	0.06	0.05	0.01	0.23
C	77	0.06	0.04	0.00	0.20
F	4	0.08	0.08	0.04	0.20
I	34	0.34	0.30	0.03	1.00
K	11	0.16	0.11	0.02	0.34

Share of Pool

Variable	Obs	Mean	Std. Dev.	Min	Max
A	116	0.48	0.31	0.00	1.14
D (Wife)	30	0.19	0.15	0.02	0.81
F	36	0.46	0.24	0.11	1.27
G	53	0.42	0.25	0.04	0.93
G (Wife)	32	0.24	0.16	0.03	0.58
H	32	0.40	0.18	0.12	0.84
I	31	0.23	0.17	0.00	0.62
I (Wife)	32	0.17	0.15	0.00	0.57

Table 3.A.6 Change in the Management Types over time

1998-2001

Type	A	B	C	D	E	F	G	H	I	J	K	L	Others
A	56.70	17.53	5.15	1.03	1.03	7.22	2.06	4.12	2.06	1.03	1.03	0.00	0.00
B	4.46	61.31	13.69	1.49	9.23	1.19	0.30	0.00	0.00	1.19	0.60	0.89	3.27
C	1.75	15.20	62.57	1.17	5.85	2.92	0.00	1.75	0.58	2.92	0.58	0.00	4.09
D	0.00	15.38	23.08	30.77	7.69	0.00	0.00	7.69	7.69	0.00	0.00	0.00	7.69
E	3.70	18.52	18.52	3.70	46.30	0.00	0.00	3.70	1.85	0.00	0.00	0.00	1.85
F	3.13	12.50	15.63	0.00	3.13	31.25	12.50	9.38	9.38	3.13	0.00	0.00	0.00
G	10.53	0.00	15.79	0.00	0.00	21.05	31.58	10.53	5.26	5.26	0.00	0.00	0.00
H	16.00	8.00	0.00	4.00	8.00	16.00	4.00	40.00	4.00	0.00	0.00	0.00	0.00
I	10.00	0.00	20.00	0.00	0.00	0.00	5.00	0.00	50.00	0.00	0.00	0.00	10.00
J	8.00	12.00	24.00	0.00	0.00	8.00	8.00	4.00	8.00	24.00	4.00	0.00	0.00
K	7.14	21.43	7.14	0.00	7.14	7.14	0.00	0.00	0.00	14.29	28.57	7.14	0.00
L	0.00	66.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	0.00	0.00	0.00
Others	2.27	22.73	27.27	4.55	0.00	11.36	4.55	2.27	9.09	6.82	0.00	0.00	9.09

2001-2003

Type	A	B	C	D	E	F	G	H	I	J	K	L	Others
A	56.58	18.42	2.63	1.32	3.95	1.32	3.95	10.53	0.00	0.00	0.00	0.00	1.32
B	5.76	55.14	21.81	2.06	5.76	2.06	0.41	1.23	0.41	2.47	0.82	0.00	1.65
C	0.63	11.25	65.63	2.50	6.88	1.25	0.63	2.50	0.00	2.50	1.25	0.63	3.13
D	0.00	26.32	21.05	31.58	5.26	0.00	0.00	5.26	0.00	10.53	0.00	0.00	0.00
E	1.49	14.93	25.37	5.97	38.81	4.48	1.49	2.99	1.49	0.00	0.00	0.00	2.99
F	5.41	2.70	21.62	0.00	0.00	29.73	10.81	10.81	2.70	5.41	2.70	2.70	0.00
G	12.50	0.00	12.50	0.00	6.25	12.50	31.25	6.25	6.25	12.50	0.00	0.00	0.00
H	0.00	4.35	13.04	0.00	8.70	17.39	8.70	34.78	13.04	0.00	0.00	0.00	0.00
I	4.76	9.52	4.76	0.00	0.00	0.00	4.76	9.52	42.86	14.29	0.00	4.76	0.00
J	10.00	10.00	35.00	0.00	0.00	0.00	5.00	5.00	5.00	15.00	5.00	5.00	5.00
K	33.33	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.67	0.00	0.00
L	0.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	0.00
Others	6.25	18.75	43.75	0.00	6.25	0.00	6.25	0.00	6.25	0.00	0.00	0.00	12.50

1998-2003

Type	A	B	C	D	E	F	G	H	I	J	K	L	Others
A	46.07	19.10	4.49	1.12	4.49	4.49	5.62	7.87	2.25	0.00	0.00	0.00	2.25
B	5.07	46.74	26.09	1.81	9.78	1.45	0.36	2.17	0.00	1.45	0.72	0.36	3.26
C	2.08	10.42	66.67	3.47	6.25	2.78	0.69	2.78	1.39	0.69	0.00	0.69	1.39
D	9.09	9.09	36.36	36.36	0.00	0.00	0.00	0.00	0.00	9.09	0.00	0.00	0.00
E	4.65	18.60	16.28	6.98	41.86	2.33	0.00	6.98	2.33	0.00	0.00	0.00	0.00
F	4.00	8.00	24.00	0.00	4.00	32.00	4.00	8.00	12.00	0.00	4.00	0.00	0.00
G	0.00	10.00	15.00	0.00	0.00	10.00	35.00	10.00	10.00	5.00	0.00	5.00	0.00
H	12.00	8.00	4.00	0.00	8.00	16.00	12.00	28.00	4.00	0.00	4.00	0.00	0.00
I	7.14	7.14	28.57	0.00	7.14	0.00	0.00	0.00	35.71	7.14	0.00	7.14	0.00
J	8.70	13.04	13.04	0.00	8.70	8.70	0.00	8.70	4.35	21.74	8.70	0.00	4.35
K	20.00	10.00	30.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	20.00	10.00
L	0.00	50.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	13.51	10.81	35.14	5.41	2.70	2.70	2.70	2.70	0.00	18.92	0.00	0.00	0.00

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